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"CENTRAL ATLANTIC" TYPE PASSENGER LOCOMOTIVE.

With Traction Increaser.

New York Central & Hudson River Railroad.

Built by Schenectady Locomotive Works.

This engine is a notable one which is sure to attract a great deal of attention, not only because of its large capacity but because it represents a development of a four-coupled engine with an unusual amount of tractive weight, the limits of which are by no means exhausted in this case. It stands for a high development of the "Atlantic" type, which is a wheel arrangement at this time exceedingly popular for fast passenger service.

Mr. Waitt had in mind, first of all, boiler power sufficient to insure 200 lbs. steam pressure under all conditions of service, and to secure this a wide, short grate with a large area was used, supplemented by a larger heating surface than has ever before been given to a passenger locomotive. The heating surface is only 598 sq. ft. smaller than that of the Lehigh Valley consolidation pushing engines, which have 4,103 sq. ft. This design does not appear to indicate opposition to the 10-wheel engine as a type, but it represents a desire to use but four coupled wheels in this service. To carry the weight involved in this able boiler, ten wheels were necessary and the "Atlantic" type was selected. To secure to this type the advantage of a six-coupled engine in tractive weight for starting, a traction increaser is used whereby a portion of the truck and trailer weights may be temporarily transferred to the driving wheels in starting. In this lies the chief point of interest in the design. To these features large wheels, large cylinders, 12-in. piston valves with unusually large steam passages are added.

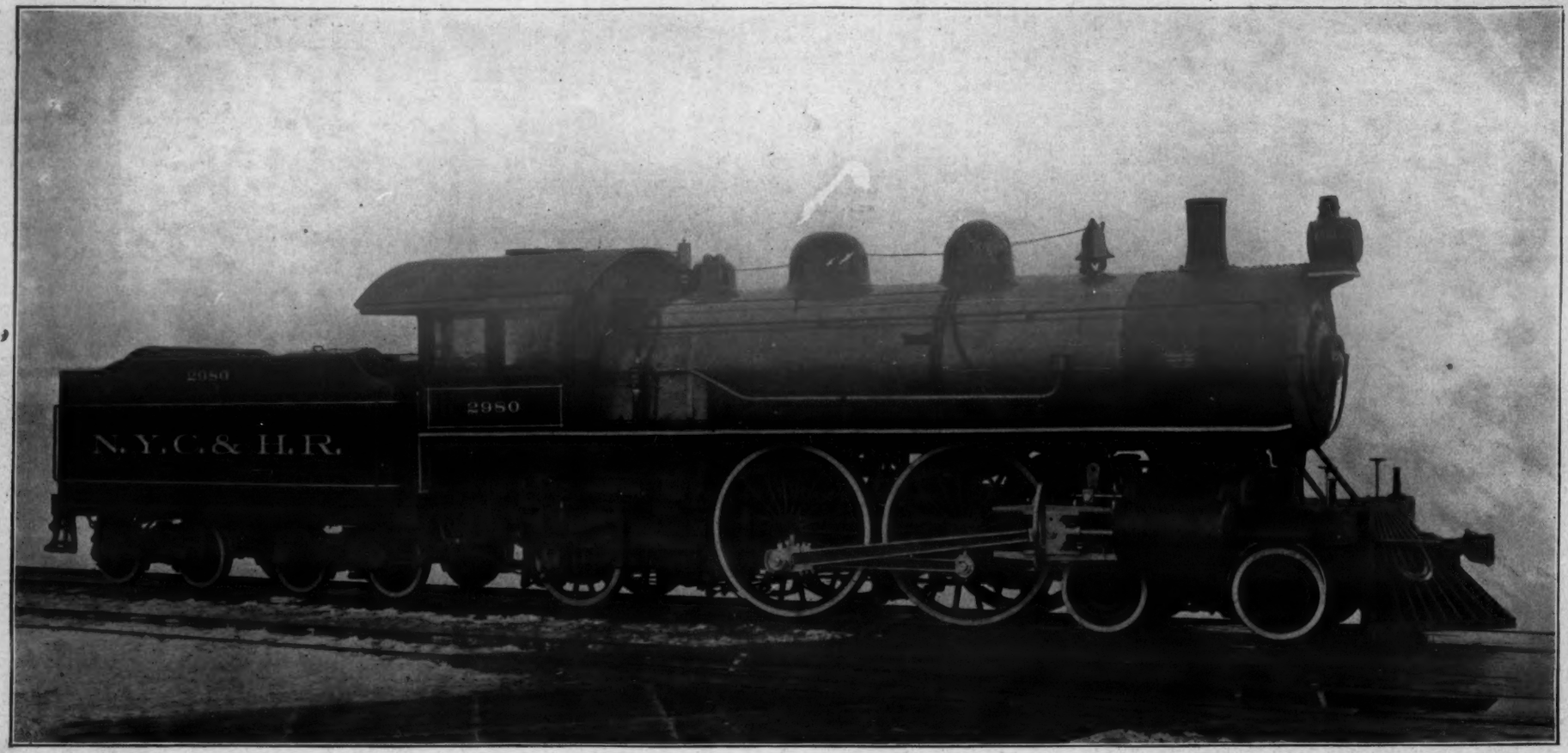
The first of these engines completed weighed 176,000 lbs. The weight on drivers was 94,800 lbs., exactly 200 lbs. less than the calculation; the weight on the trucks was 42,600 lbs. and on the trailers 38,600 lbs. The total weight of the Chicago & Northwestern engine is 160,000 lbs., with 90,000 lbs. on the drivers. The heating surface of the Northwestern engine is 3,015 sq. ft. (See American Engineer, August, 1900, page 237.)

The traction increaser attachment is illustrated in the drawings. It changes the fulcrums of the equalizers between the rear driving wheels and the trailers, thereby changing the distribution of weight. The position of the center of gravity of the engine is not changed, but the center of support is moved ahead, which transfers 12,000 lbs. from the truck and trailers to the driving wheels, making the weight on drivers about 107,000 lbs. when it is in use. It is obvious that any desired increase may be effected by selecting the proper distance through which the equalizer fulcrums are moved.

The fulcrums are not actually moved; the normal fulcrums are exchanged for others 5½ ins. further ahead by means of a pair of 8 by 12-in. air-brake cylinders operating through levers, as shown in the detail drawing. The normal fulcrums seat in steel castings bolted to the supplemental plate frames at the front of the firebox. The other fulcrums are made by a cross bar which in its normal position is held above the equalizers and long enough to extend across over both equalizers. This bar is carried by links attached to the air cylinder levers, and when air pressure is applied from the cab the cylinders push the cross bar down to its seats on top of the equalizers and transfer the weight as described. The air cylinders have sufficient stroke to take the weight entirely off the normal fulcrums. Vertical slabs 10½ ins wide, bolted to the frames and tied together across the engine, carry the air cylinders. The drawings also illustrate the guides for the air cylinder levers and the other details. The rear ends of the air cylinder levers are forked and their fulcrums are links bearing on pins through lugs in the equalizer fulcrum casting. This device was worked out by the Schenectady Locomotive Works and it appears to have been very well done. To remind the engineer to throw off the traction increaser after starting, a small air whistle is attached to the air pipe. It will blow while the device is in use.

In general, the engine is similar in appearance to the "Northwestern" type, but its capacity is greater. It has the same valve motion, the same general arrangement of boiler, frames and outside bearings for the trailers. The crank pins, axles and piston rods have enlarged ends for wheel and crosshead fits. The driving axle journals are 9½ by 12 ins. and those of the trailer axle are 8 by 14 ins., with 9¼-in. wheel fits. The trailer boxes are provided with a cored passage for cooling water, whereby the bearings may be cooled without putting water directly on them, and in addition to this, water may be run into the interior of the boxes and upon the journals if necessary.

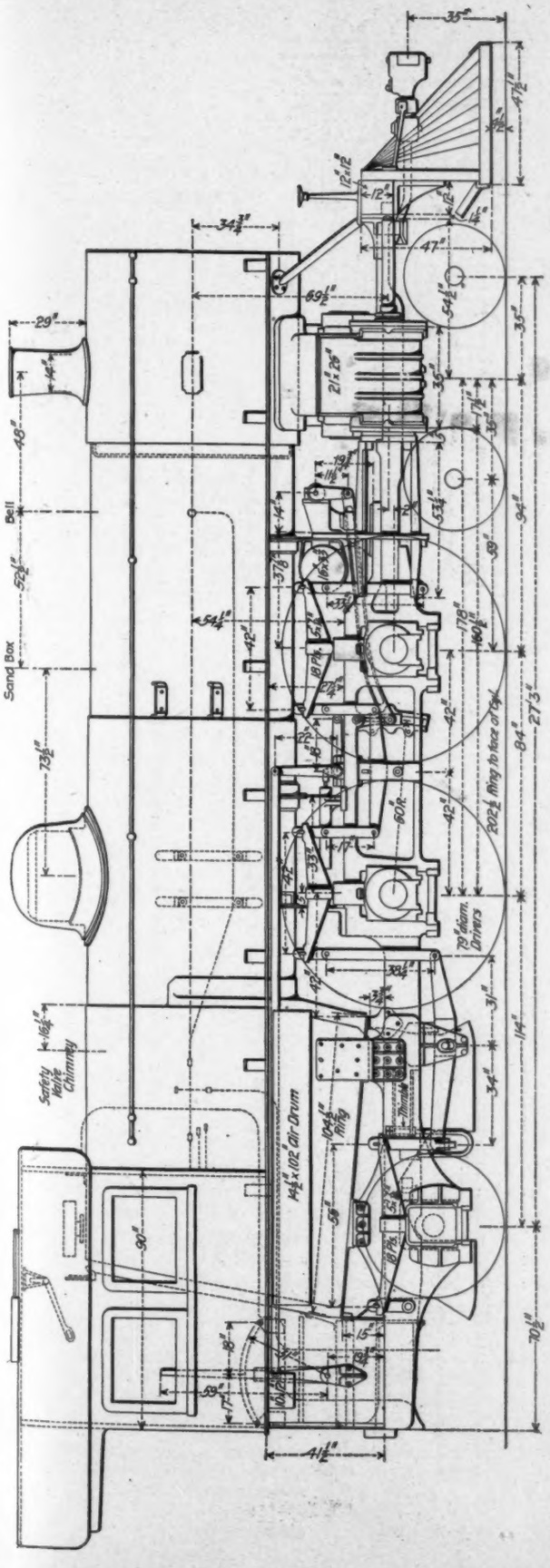
The boiler is supported by two shoes at each side under the mud ring, by a plate from the front face of the foot plate to the back head and upon a cast steel cross tie between the frames under the front end of the mud ring. The foot plate is of cast steel, very light, well ribbed and thoroughly bolted. The back end structure is stiffened by a thorough bolt of steel 1¾ ins. in diameter, through the foot plate and all four sections of the frames. There are an unusual number of cross ties to the frames, amounting to eleven in all. These are: The foot plate, a bar in front of the trailer boxes, another at the rear of the equalizer fulcrums, a cast steel bar across under the front end of the firebox, a tie over the rear driving boxes, another under the rear driving boxes, another back of the lifter shaft boxes, one at the bottoms of the forward driving pedestals, the guide yoke, the cylinders and the bumper. With these precautions there should be no breakage of cylinders. The boiler is 70⅝ ins. in diameter and its center is 111 ins. above the rail. It is plentifully supplied with washout plugs and has a mud drum in front of the firebox. The brake shoes are at the rear of the drivers and trailers and the truck wheels also have brakes. The driving brake cylinders are in front of the guide yoke. Vacuum and combina-



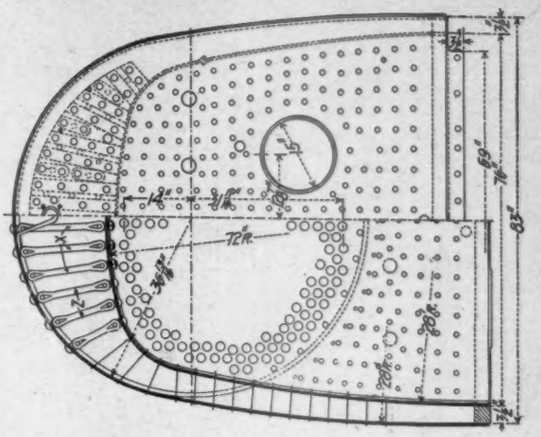
"CENTRAL ATLANTIC" TYPE HEAVY PASSENGER LOCOMOTIVE.—NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

A. M. WAITT, *Superintendent of Motive Power and Rolling Stock.* SCHENECTADY LOCOMOTIVE WORKS, *Builders.*

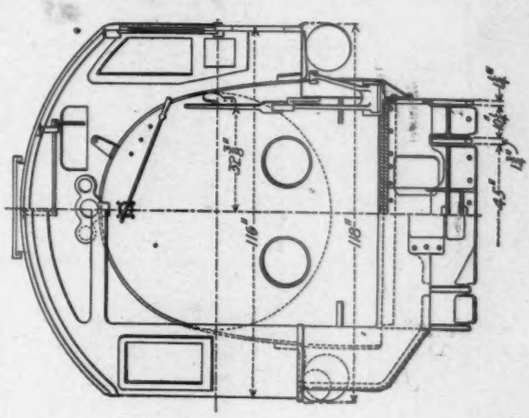
Cylinders	21 x 26 in.			Boiler pressure	200 lbs		
Wheel: Driving	79 in.;	engine truck	36 in.;	trailing	50 in.;	tender wheels	36 in.
Weights: Total of engine	176,000 lbs.;	on drivers		95,000 lbs;	total engine and tender		224,900 lbs.
Grate area and tubes: Grate area		50.30 sq. ft.		Tubes			396—2 in.—16 ft. long.
Firebox: Length	102 in.;	width	75⅝ in.;	depth of front	80¼ in.;	back	69 in.
Boiler: type, straight		radial staying.		Diameter			72 in.
Heating surface. Tubes	3,298.08 sq. ft.;	firebox		207.09 sq. ft.;	total		3,505.17 sq. ft.
Wheel base: Driving	7 ft.;	total of engine		27 ft. 3 in.;	engine and tender		53 ft. 0 in.
Tender	Eight-wheel;	water capacity	5,000 gals.;		coal capacity	10 tons.	

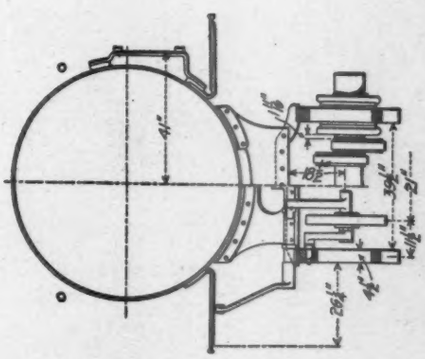


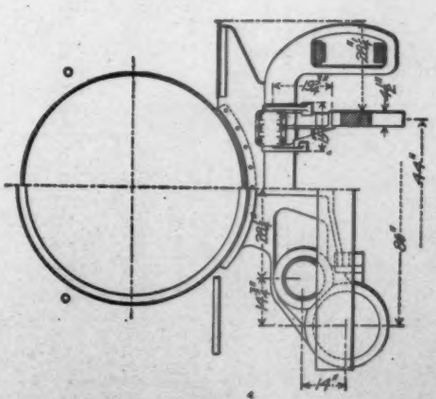
Side Elevation.



Section of F rebox.

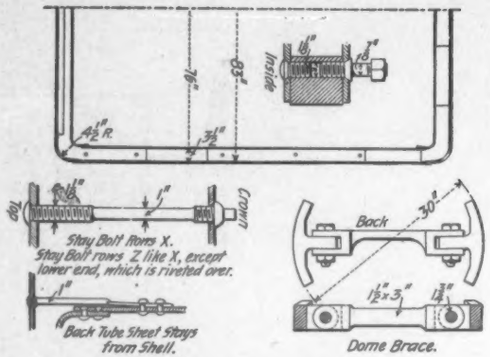




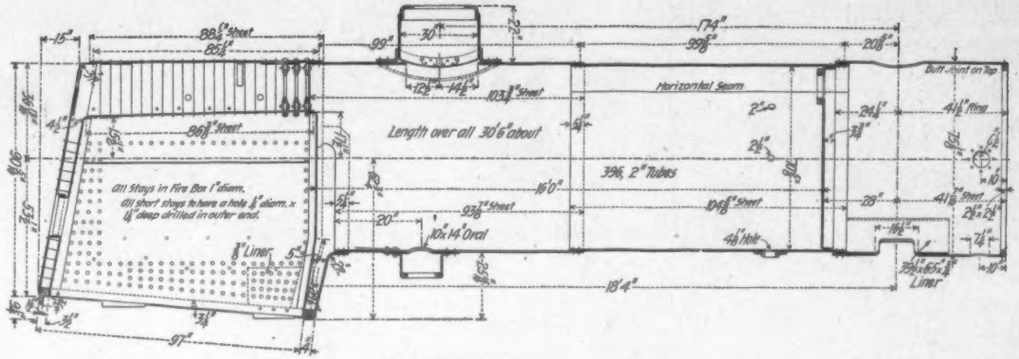


Half Rear and Front Elevations and Sections.

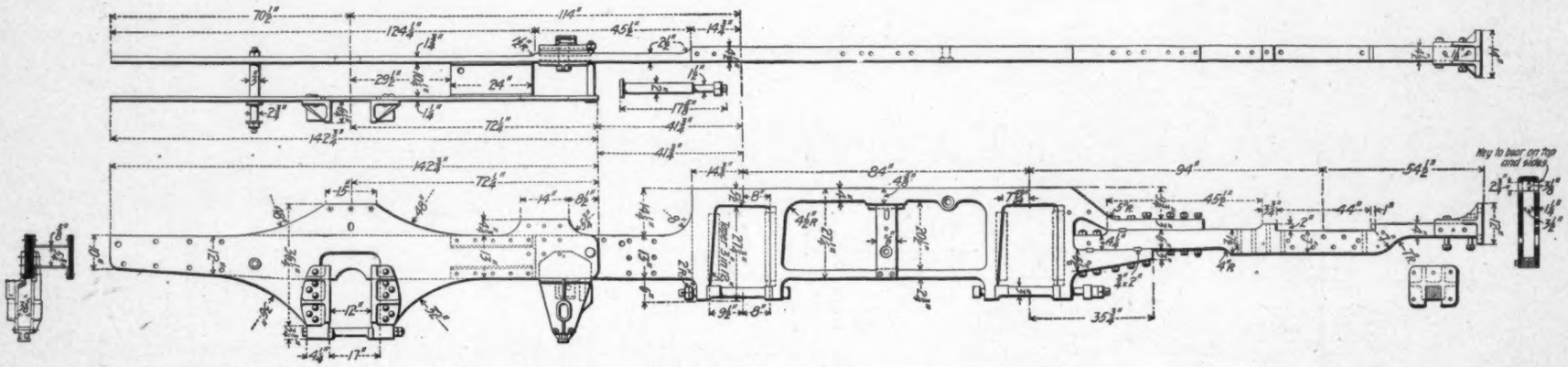
"Central Atlantic" Type Passenger Locomotive—New York Central & Hudson River Railroad.


Stay Bolt Rows X.
Stay Bolt rows Z like X, except lower end, which is riveted over.
Back Tube Sheet Stays from Shell.
Back
Dome Brace.

Some of the Boi er Details.

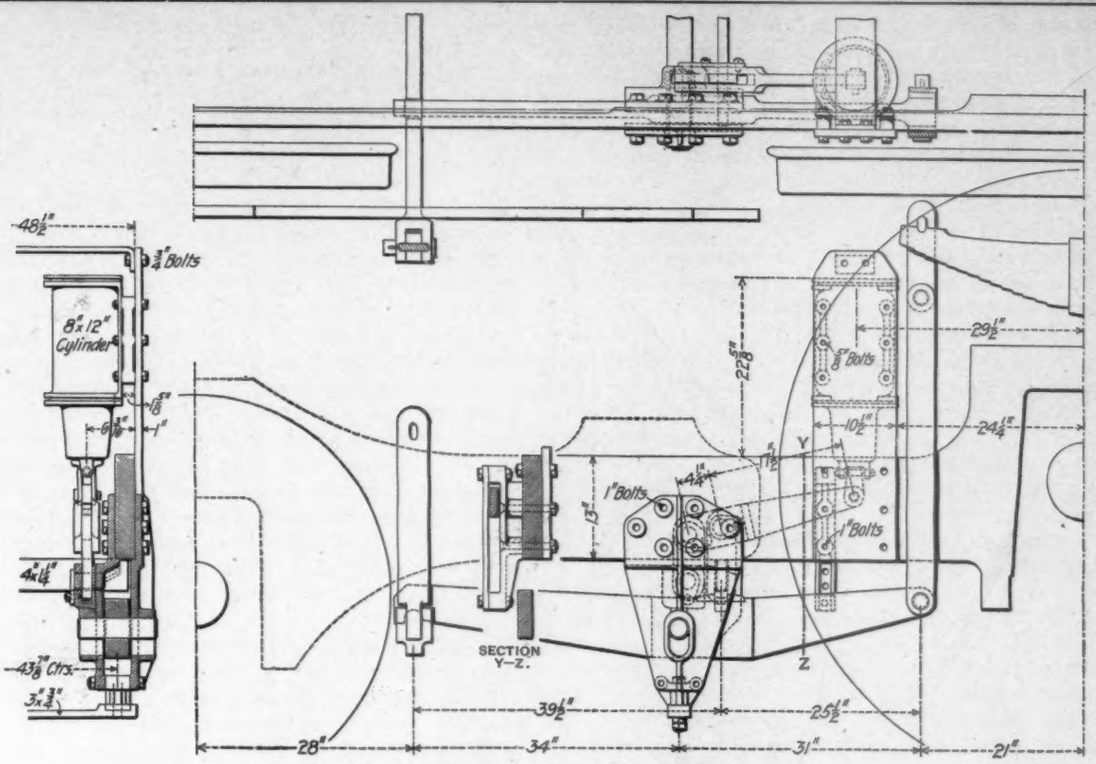

All Stays in Fire Box 1" diam.
All short stays to have a hole 1/8" diam. x 1/8" deep drilled in outer end.
Length over all 30'6" about
396, 2" Tubes
Horizontal Seam
Built Joint on Top
Liner

Longitudinal Section of Boiler.



Views of Frames Showing Supplemental Frame for Trailing Boxes.

"Central Atlantic" Type Passenger Locomotive—New York Central & Hudson River Railroad.



Traction Increaser Operated by Compressed Air.

tion water relief and by-pass valves are fitted to the cylinders.

The valve setting measurements on the first engine of the lot are unusually uniform. They are as follows:

Valve Motion Characteristics.

No. of notches.	Lead.		Valve opens.		Cut off.	
	Front stroke.	Back stroke.	Front stroke.	Back stroke.	Front stroke.	Back stroke.
	Inches.	Inches.	Inches.	Inches.	Inches.	In hes.
Left 1	0	0	2	2	23	23 1/16
Right	0	0	2	2	23 1/16	23 1/8
2	1/16	1/16	1 3/4	1 3/4	21	21 1/16
3	3/32	3/32	1 13/16	1 13/16	19	19
4	1/8	1/8	1 11/16	1 11/16	17	17
5	7/32	7/32	5/8	5/8	15	15
Left 6	¼ S	¼ S	1 1/16	1 1/16	13	13
Right	¼ S	¼ S	1 1/16	1 1/16	13	13
7	¼ F	¼ F	7/16	7/16	11	11
8	3/32 S	3/32 S	1 3/16	1 3/16	9	9
	3/32	3/32	1 1/16	1 1/16	6	6 1/16

The slip of the links is 1¼ ins. in forward motion, 1 1/16 ins. in back motion and ⅞ in. at half stroke. The valves are set "line and line" in both motions and with 9/32 in. lead at 6-in. cut-off.

This is one of the leading designs of the past year, and is exceedingly important in indicating the tendency toward greatly increased power and sustained steam-making capacity for handling heavy passenger trains, as well as increased power for starting trains. It should be stated that the operating officers of the road are opposed to hauling more than 10 cars in passenger trains, and with this fact in view this engine is believed to have sufficient tractive weight. The engines will be used on through passenger trains, including the "Empire State Express," when it has an additional car, which brings it to a weight which is beyond the capacity of the eight-wheel engines. The chief dimensions are as follows:

General Dimensions.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal
Weight in working order	176,000 lbs.
Weight on drivers	95,000 lbs.
Wheel base, driving	7 ft. 0 in.
Wheel base, total of engine	27 ft. 3 ins.
Wheel base, total of engine and tender	53 ft. 0 in.
Diameter of cylinders	21 ins.
Stroke of piston	26 ins.
Horizontal thickness of piston	5 ins.
Diameter of piston rod	3¾ ins.
Kind of piston packing	Cast iron rings
Kind of valves	12-in. piston valve
Greatest travel of valves	6 ins.
Outside lap of valves	1 in.
Inside clearance of valves	⅛ in.
Lead of valves in full gear	Line and line, 0 in.
Diameter of driving wheels outside of tire	79 ins.
Material of driving wheel centers	Cast steel
Driving box material	Cast steel
Diam. and length of driving journals	9½ ins. dia. by 12 ins.
Diam. and length of main crank pin journals	6½ ins. dia. by 7 ins.
Diam. and length of side rod crank pin journals,	Main side, 7 ins. by 4¼ ins.; front, 5 ins. dia. by 4 ins.
Engine truck journals	6¼ ins. dia. by 10 ins.
Diameter of engine truck wheels	36 ins.
Kind of engine truck wheels,	Krupp disc center, with 3⅛ ins. steel tire

Boiler.

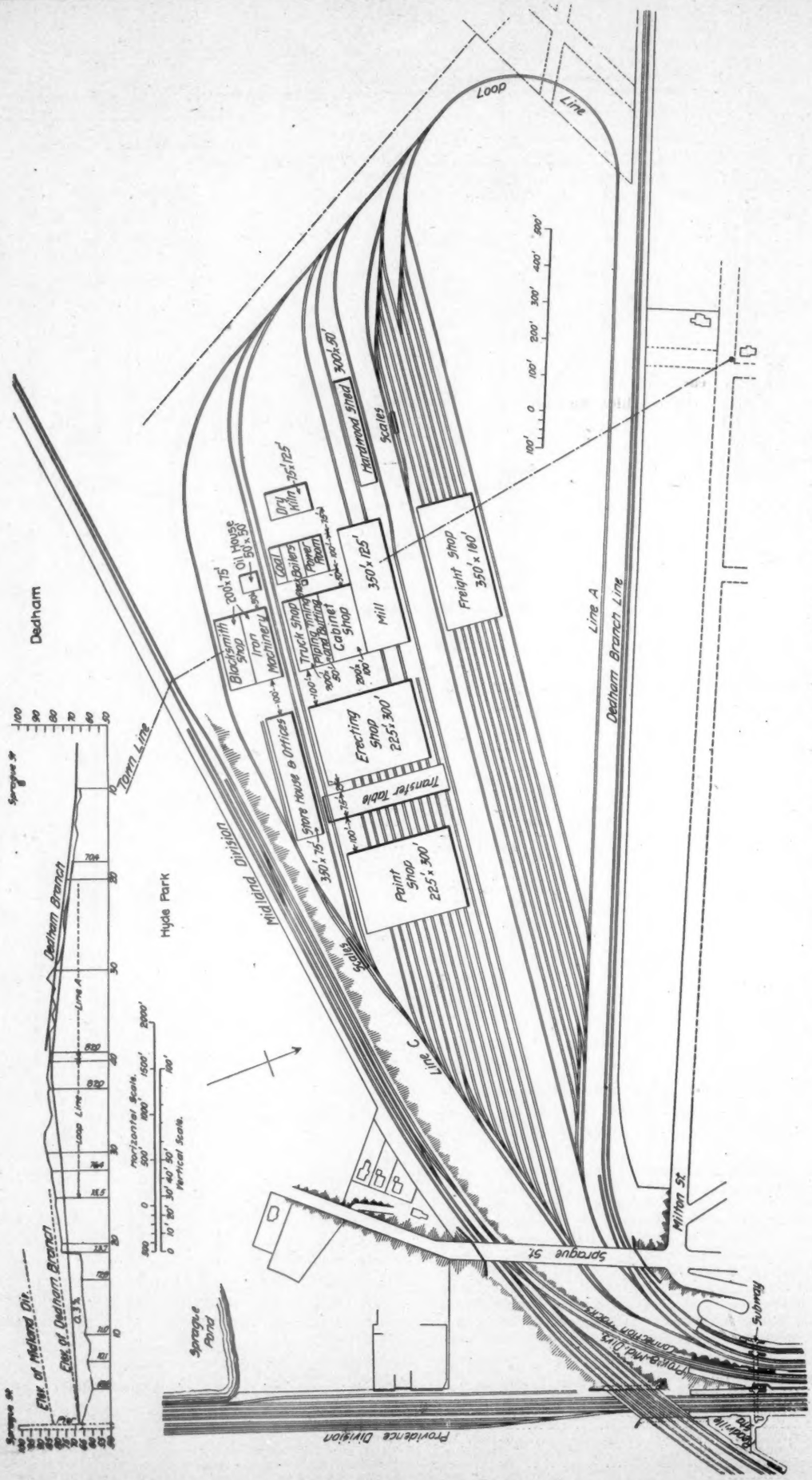
Style	Straight, with wide firebox
Outside diameter of first ring	72 ins.
Working pressure	200 lbs.
Firebox, length	102⅛ ins.
Firebox, width	75⅝ ins.
Firebox, depth	80¼ ins. front, 69 ins. back
Firebox plates, thickness	Sides, 5/16 in.; back, ⅜ in.; crown, ⅜ in.; tube sheet, ½ in.
Firebox, water space	Front, 4 ins. to 5 ins.; sides, 3½ ins. and 5½ ins.; back, 3½ ins. and 4½ ins.
Firebox crown staying	Radial stays, 1⅛ ins. diam.
Firebox staybolts	1 in. diam.
Tubes	396, 2 ins. diam., 16 ft. long
Fire brick, supported on	Water tubes
Heating surface, tubes	3,298.08 sq. ft.
Heating surface, water tubes	27.09 sq. ft.
Heating surface, firebox	180 sq. ft.
Heating surface, total	3,505.17 sq. ft.
Grate surface	50.32 sq. ft.
Ash pan	Plain, with dampers front and back
Exhaust pipes	Single
Exhaust nozzles	5 ins., 5¼ ins. and 5½ ins. diam.
Smoke stack, inside diameter	14 ins.
Smoke stack, top above rail	14 ft. 10 ins.
Boiler supplied by	Two Nathan & Co. Monitor injectors No. 11

Tender.

Weight, empty	48,900 lbs.
Wheels, diameter	36 ins.
Journals, diameter and length	5 ins. dia. by 9 ins.
Wheel base	16 ft. 6½ ins.
Tender frame	10-in. steel channels
Tender trucks	Fox pressed steel, bolster type
Water capacity	5,000 U. S. gals.
Coal capacity	10 tons

Special Equipment.

Westinghouse-American combined brakes on drivers and engine truck, on tender and for train.
Franklin Sec. lagging on boiler and on cylinders. Removable section over staybolts.
Three 2½-in. Consolidated muffled safety valves.
Leach sand feeding apparatus.
Sansom bell ringer.
Tank equipped with water scoop, operated by air.
National hollow brake beams on tender.
Gould coupler at front of engine and rear of tender.



New Car Shop Plant, New York, New Haven & Hartford Railroad, at Readville, Mass.

W. P. APPLEYARD, *Master Car Builder.*

C. M. INGERSOLL, JR., *Chief Engineer.*

JOHN HENNEY, *Superintendent Motive Power.*

NEW CAR SHOPS.

New York, New Haven & Hartford Railroad.

Large Plant Exclusively for Cars At Readville, Mass.

With Electric Distribution of Power.

A few of the peculiar conditions affecting the operation of the New York, New Haven & Hartford Railroad are the following: Its total mileage is 2,060 and the longest direct run, from New York to Boston, is 232 miles. The total number of passenger trains, averaging five cars each, is 1,970 every 24 hours and this employs but 1,860 cars. The road has 13,000 freight cars of its own and handles from 50,000 to 60,000 foreign freight cars per day, which means that the car department must maintain nearly 75,000 freight cars and 1,860 passenger equipment cars, of which 120 are parlor or sleeping cars owned and operated by the road. The road is made up of a number of short lines, each having previously operated its own shop equipment, a method which has been followed until it now becomes necessary to concentrate the heavy car work at one place, while light work will be done at two others—East Hartford and New Haven. For the large shop plant, Readville, nine miles from Boston, was selected because of its convenience. An angle between the Midland division and the Dedham branch offered 70 acres in a favorable shape with good track facilities and the possibility of extending a track by a loop entirely around the grounds. In this space shops having a capacity for 180 passenger cars, for all classes of repairs that include varnishing, and 1,000 freight cars for general repairs per month are to be provided, the plant being exclusively for car work. A combination of locomotive and car shops was considered here because, being on the main line to New York and also on the Midland division (formerly the New York & New England) the location was equally favorable for locomotive work, but the car plant was considered large enough to justify complete separation of the work.

The shops provide for the housing of 60 passenger cars and 60 freight cars at one time. The plan illustrates the arrangement of the buildings with the passage or "Midway" 100 ft. wide between the freight repair tracks and the shops. This is a roadway which will always be kept open and will be most valuable in fire protection, the fire precautions being well worked out. The buildings are as follows:

Paint shop	225 x 300 ft.
Erecting shop	225 x 300 ft.
Storehouse and offices	75 x 350 ft.
Blacksmith shop	75 x 200 ft.
Truck shop	50 x 200 ft.
Piping, tin and buffing	50 x 200 ft.
Cabinet shop	100 x 200 ft.
Mill	125 x 350 ft.
Freight shop	160 x 350 tt.
Oil house	50 x 50 ft.
Power house	100 x 150 ft.
Dry kiln	75 x 125 ft.
Hardwood shed	50 x 300 ft.

In the passenger car shops there are 10 tracks at 24 ft. centers, each holding three cars, making 60 cars in all. These shops are exactly alike, with a second story in the south ends for the varnish rooms, upholstery shop and toilet rooms. The details of the buildings will be taken up in a future article, the present purpose being to direct attention to the general plan. Between the paint shop and the transfer table the tracks have a length of 100 ft. This space will be used for stripping and scrubbing cars and for storage while waiting to get into the shops. This space also permits of clearing the erecting shop promptly without waiting for cars to be removed from the paint shop tracks.

The shops requiring machinery are grouped together in a very compact space with a 100-ft. passage between them and the erecting shop and storehouse. The power distribution is to be entirely by electricity and in this passage a small electric trolley will serve the shops and take material in push cars to tracks leading to the shops where it is to be used. The freight repair shop comes also to this line and is of the same length as the mill. The freight shop is between two yards. It has seven tracks at 20-ft. centers and, as stated, will house 60 cars at a time. It is the intention to place bad order cars in the yard at the east end of this shop and have them move progressively to the right through the shop and out to the yard at the west end. The yard at the east end of the shop will hold about 500 cars. The freight work is therefore near the shops and material may be delivered easily from the other shops and the mill. The lumber yard is west of the dry kiln and the mill, this part of the plant being laid out with a view of progressive movement of material to and through the mill with no backward or side steps, and while the plant is very large the "magnificent distances" of some recent shop plant plans have been avoided. The whole plant, in fact, embodies the progressive movement idea throughout as the plan clearly indicates

It is the intention to dismantle passenger cars on the track south of the erecting shop. The trucks will then go to the truck shop, which will have two electric traveling cranes and the cars will be taken to the erecting shop on low trucks. The arrangement of buildings throughout is such as to save unnecessary handling of material. The oil house, iron machine shop, truck shop, store house and coal bin of the power house are all served by two parallel tracks. All wheel work and heavy parts and stores may be most conveniently handled here and the buildings used for light work are placed where they are most convenient. The hardwood shed and dry kiln are very large buildings of their kinds, which is necessary because of the large amount of cabinet work on the sleepers and parlor cars; this also necessitated a large cabinet shop.

The steam pipes for heating the buildings will be carried overhead and this also applies to all piping, as far as it may be treated in this way.

These plans were decided upon by Mr. John Henney, Superintendent Motive Power, and Mr. W. P. Appleyard, Master Car Builder, in co-operation with Mr. C. M. Ingersoll, Jr., Chief Engineer. We are indebted to these gentlemen for information and drawings, and we expect to describe the buildings and other features of the plant in future articles. The plant is an important one and its arrangement and also the interesting details will be suggestive to others who are engaged upon such problems. We expect to completely describe the buildings and the machinery in two subsequent articles. That concerning the machinery will be reserved until the work is completed.

That French locomotive boilers are not lagged with heat insulating material is rather surprising. We are told in the "Railroad Gazette," that instead of providing non-conducting material under the jacket, an air space of 2 or 3 ins. in thickness is left between the jacket and the boiler for the purpose of saving loss of heat. This is a convenient and cheap heat insulation but its efficiency depends largely upon the tightness of the jacket. A few leaks or a circulation of air will destroy its efficiency. In fact, the leakage of air from the jacket impairs the value of all boiler coverings and must be carefully guarded.

A reform in the interest of healthful conditions of railroad travel has begun on the Chesapeake & Ohio by the removal of fret, grillwork and other dust depositories from its passenger cars. If is done without sacrifice of art in ornamentation and the result is altogether an improvement. The good work should not stop until all plush, heavy hangings, carpets and fuzzy blankets are removed from parlor and sleeping cars. These should give place to materials which may be washed or disinfected at the end of every trip. Specialists insist that this reform is necessary. It seems reasonable, and we have no doubt that too little attention is given to these precautions. The fact that the improvements tend in the direction of economy should help the good work along.

100,000 Pounds Capacity Composite Hopper Coal Cars, with Steel Framing—Norfolk & Western Railway.

W. H. LEWIS, *Superintendent Motive Power.* C. A. SELEY, *Mechanical Engineer.*

COMPOSITE HOPPER COAL CARS 100,000 POUNDS CAPACITY.

With Steel Frames and Wooden Hoppers.

Norfolk & Western Railway.

About eighteen months ago the Norfolk & Western Railway began building 50-ton capacity cars having steel underframing and wooden hoppers, illustrations and description of the design were given in the June, 1899, issue of the American Engineer, page 187.

One thousand of these cars were built at the Roanoke shops of this company, and have been in their exclusive service, not leaving their line. These cars are run in solid trains between the mines in West Virginia and tidewater, producing a remarkable car mileage, as high as 2,600 miles per month.

Their design may be described briefly as follows: The carrying members are 15-in., 33-lb. steel channels with a built-in bolster of plates and bars. The side planks of the box or hopper are bolted to wooden posts, which are secured to the side sills with cast-iron pockets and bolts. The inclined chute planks are of oak and three pairs of doors are hung from hinge bars extending across the car, which are supported by strap bolts riveted to the sills. The doors are operated by winding shafts with ratchet wheels on the sides of the cars, the chains winding on grooves in the wheels. The end doors have check chains to limit their opening and direct the flow of the coal to suit the openings in the unloading docks. The weight of these cars when new was about 40,000 lbs., but at the present time, owing to the drying out of the lumber, their weight averages about 39,500 lbs.

The April, 1900, issue of the American Engineer illustrated another style of composite car in use on the Norfolk & Western. This is a 40-ton, flat-bottom, drop-door gondola, and is a radical departure in car design. The heavy side sill and the wooden stakes of the previous design are omitted, and the sides of the car are supported by a steel truss, of which the top coping angle and the side sill are respectively the top and bottom chords and the verticals and diagonals are 5-in. channels, taking the place of the stakes, and to these the side planks are attached. The saving in weight by the use of the truss is over 1,000 lbs. per car as compared with the heavy sill design with wooden stakes. The bolsters of these cars are very strong, both for carrying and for resisting side bearing thrust which is very severe on this road, owing to heavy curvature. Five hundred of these cars are in service and have given perfect satisfaction, no defect in the design having become apparent.

The success of the truss feature of these cars in reducing weight and cost has brought about its introduction into a revised plan for 50-ton cars, which has recently been made, and a sample car built. The working drawings and an illustration from a photograph of the car are shown herewith, by courtesy of Mr. W. H. Lewis, Superintendent of Motive Power of the Norfolk & Western. The Roanoke shops have begun the construction of a large order (we believe 900) of these cars. This car and the 40-ton gondola were designed by Mr. C. A. Seley, Mechanical Engineer of the Norfolk & Western, and they represent original ideas in the use of structural steel in car construction.

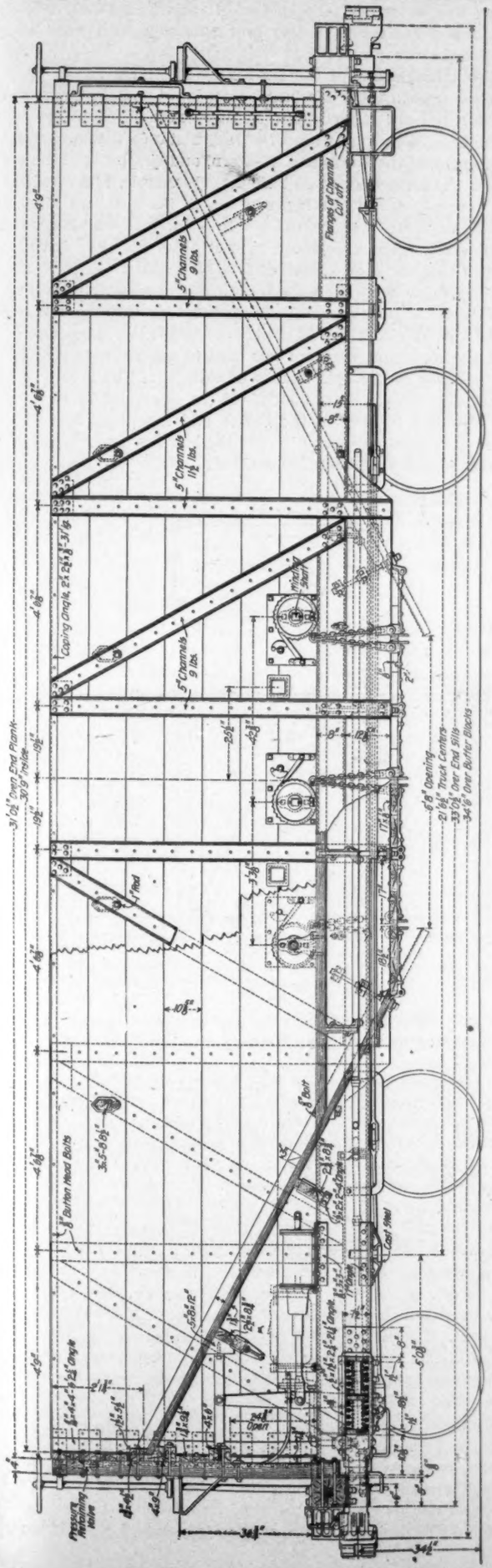
A comparison of the three cars mentioned is given herewith in tabular form, and in explanation of the high lading of the gondola it may be stated that much of the coal that is carried by the Norfolk & Western exceeds the generally recognized standard of weight of 54 lbs. per cubic foot, and it was found that the usual tipple lading would often exceed the marked capacity of the car and the customary 10 per cent. excess. It was, therefore, decided to raise the stenciling to 85,000 lbs., and allow the 10 per cent. The weighmasters' books show frequent ladings of 93,000 in these cars. The average lading of the 50-ton cars is about 105,000, although 109,000 and a few cases of 110,000 lbs. have been reported on arrival at the coal piers. The loading of the sample car here illustrated was done by hand at Roanoke with wet coal, and weighed 112,000 lbs., light weight 38,000 lbs., total 150,000 lbs.

Class Designation.	GG.	HF.	HG.
Marked capacity (excess allowance, 10%)	85,000	100,000	100,000
Cubical contents, even full, cu. ft.	1,336.76	1,598.92	1,608.86
Maximum service load	93,000	110,000	110,000
Weight of two trucks	14,300	15,500	15,500
Weight of body	18,200	24,400	22,500
Av. weight of car, complete, new	32,500	39,900	38,000

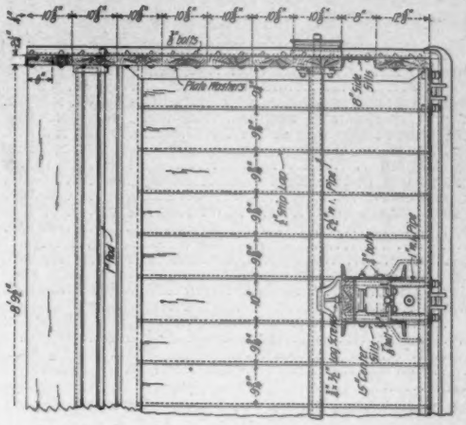
The new 50-ton cars have the following general dimensions:

Length over body	31 ft. ½ in.
Length over end sills	33 ft. ½ in.
Width over body (not including stakes)	9 ft. 2 in.
Distance between truck centers	21 ft. 6½ in.

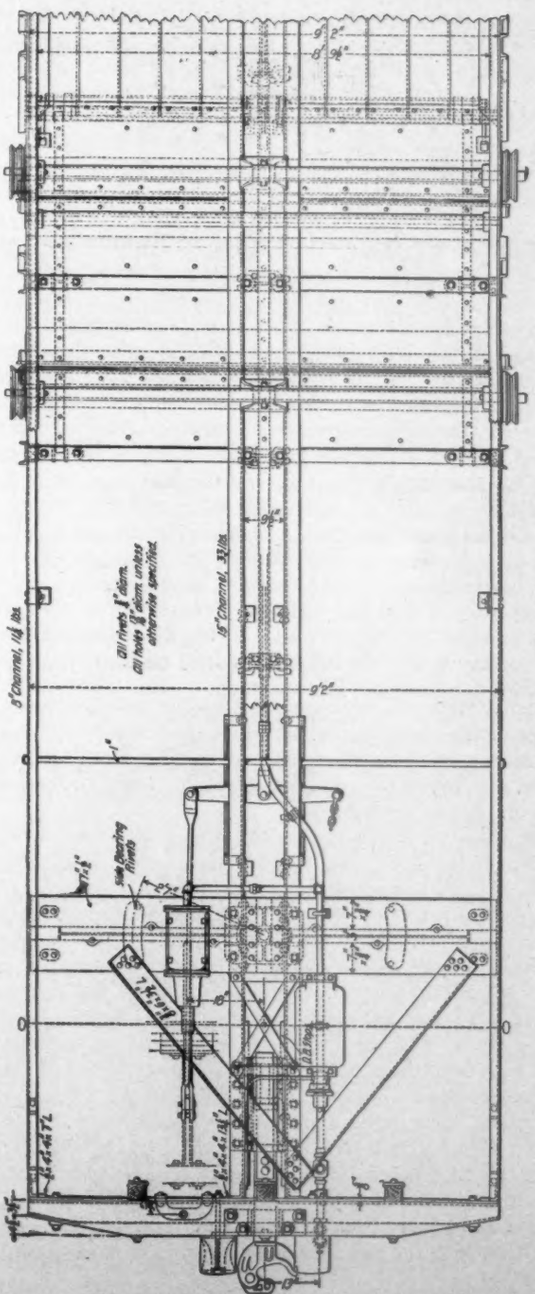
The construction of the steel frame is clearly shown by the



Half Longitudinal Section and Elevation.



Vertical Section.



Portion of the Plan.

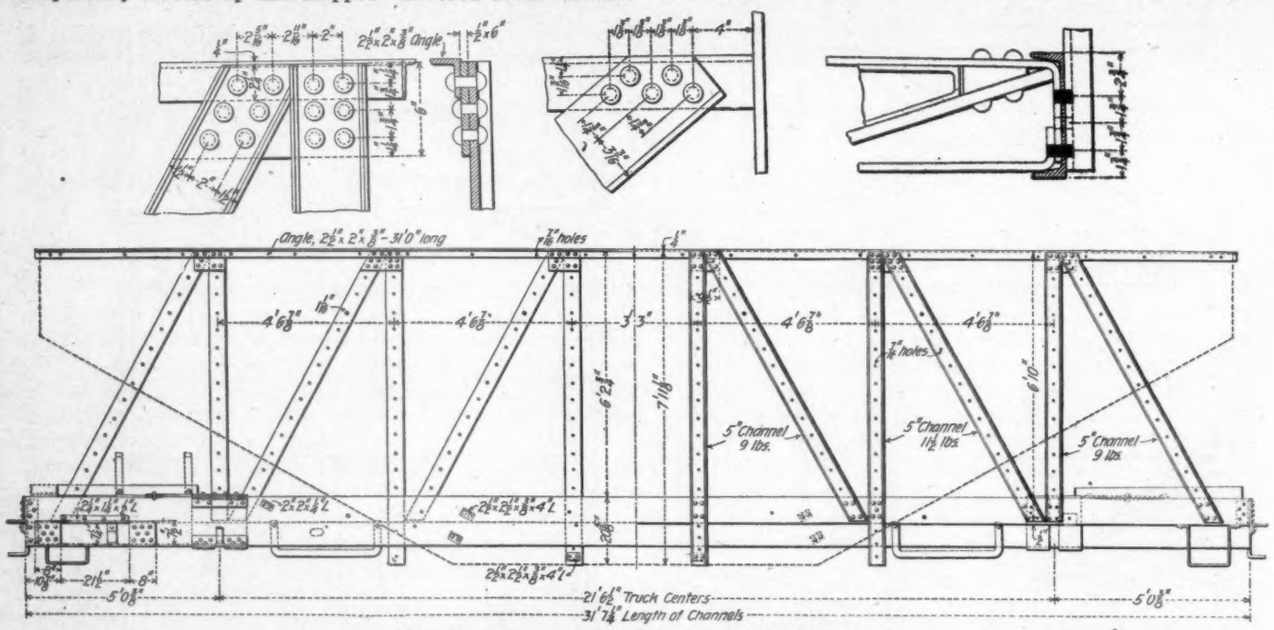
100,000 Pounds Capacity Composite Hopper Coal Cars—Norfolk & Western Railway.

Note.—The diagonal bracing, shown in the plan, is arranged to accommodate the air brake cylinder; at the other end it is symmetrical.

drawings, but for convenience the sizes of the principal members are given as follows:

Center sills	15-in., 33-lb. channels
Side sills	8-in., 11½-lb. channels
Posts and braces	5-in., 9 and 11½-lb. channels
Top coping angle	2½ in. x 2 in. x ⅜ in.
Frame corner diagonal braces	6 in. x 3½ in. x ⅜-in. angles
Corner and end connecting angles	4 ins. x 4 ins. x ½ in.
Bolster plate connecting angles	3 ins. x 3 ins. x ⅜ in.
End plate angles	5 ins. x 3 ins. x ½ in.
Body corner angles	4 ins. x 4 ins. x 5/16 in.
Post and brace top connection	6 ins. x ½ in.
Top bolster plates	17 ins. x ½ in.
Bottom bolster plates (2)	7 ins. x ¾ in.
End plates	11 ins. x ⅝ in.
All rivets	¾ in.
Side plank	2¼-in. pine
Chute plank	1¾-in. oak
Truck bolsters (2)	10 in. 35-lb. I beams
Spring plank	12 ins., 30-lb. channel
Arch bars	1½ ins. x 4½ ins.
Tie bars	½ in. x 4½ ins.
Journals	5¼ ins. x 9 ins.
Wheels	650-lb.
Center plates	Cast steel

It will be noted that the steel frame drawing shows "open holes," i. e., where rivets are to be omitted until the frames are erected in the erecting shop. This is so shown for the convenience of the riveting shop where the center sills are riveted up with the bolsters, end plates and attachments, and the sides are separately riveted up and shipped "knocked down" to the erecting shop. Here the sides are lifted up and bolted to place, the balance of the rivets are driven, the buffer beams, couplers and attachments, air brakes, center plates and side bearings are applied, the frames placed upon the trucks, ready to receive the woodwork and trimmings.



Side Elevation and Some Details of Steel Framing.

100,000 Pounds Capacity Hopper Coal Cars—Norfolk & Western Railway.

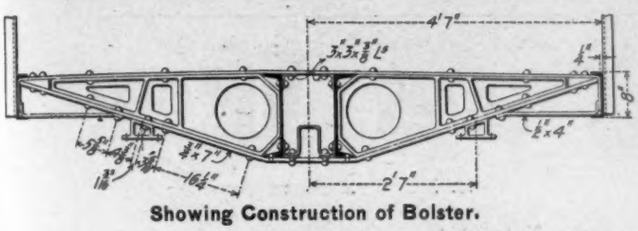
Although the steel frame of this car is so unlike that of its predecessor, the style, HF, yet the box, doors, winding apparatus, brakes, etc., are almost identical. The designer was fortunate in being able to preserve the standards adopted for almost every part of the older car. The changes that were made were for the betterment of the design, based on a year's experience in the use of the HF 50-ton car. The strap bolts of the former design, used to support the hinge bars were abandoned in favor of machine bolts, suspended from angles riveted to the sills. As will be seen from the strain diagram, the center posts of the side trusses are placed opposite the centers of the 1 by 3-in. hinge bars, and these posts and bars are connected, securing thereby very effective cross-ties. Two through 1-in. round cross-ties through all sills, under the chute planks, are also additional. The protection pipes around the winding shafts have threaded ends and nuts, which are pocketed in castings bolted to the side planks. These, with the ties previously referred to, make seven cross ties, at or near the bottom of the car, between bolsters. The top of the car is tied by four 1-in. rods with wood struts and angle-iron protection.

The arrangement of the air brakes is clearly shown on the general drawing, the air brake train pipe and the brake connection rod are carried between the center sills and are fully protected. The trucks are of a design standard to the freight equipment of the Norfolk & Western, and similar to those used under the former lot of 50-ton cars. It may be remarked that the journals are 5¼ x 9 ins. and not of the standard M. C. B. size. As these cars do not go into interchange, and as no trouble has been experienced in heating of journals, the adoption of this size seems justified for this service.

The strains in car framing are difficult to accurately estimate, and there is little valuable literature to assist the designer. This is particularly true in regard to the steel or composite car. The accompanying diagram was used to approximately analyze the stresses in the side frames of this car. The arrangement of the sills is such that about 25,000 lbs. is carried by each side, but the load is deep in the center and tapers off toward the ends, so that the overhang beyond the bolsters is much less than in the ordinary rectangular car body. Properly speaking, the load is not supported at all points along its bottom line, so as to be proportional to its depth at all points, but the actual supports are about as indicated by arrowheads, which show the location of the cross bearers, door supports, etc. It would be extremely difficult, however, to calculate the effect at each of these points, and in the calculation this irregularity has been disregarded.

The reaction of the portion of the load beyond the bolsters is graphically shown by an opposing figure of equivalent area and approximately similar form, which cuts off a large portion of the weight in the first panel of the truss, which would otherwise be distributed between the bolster and the first intermediate post. It will be noted that the strains in the posts and braces of this car are opposite in effect as compared with those of the 40-ton gondola car, Class GG, the latter being a six-panel truss.

The good effect of narrowing the center panel of the truss may also be seen. The stresses will be noted as extremely low for the cross-section of the posts and braces used, but the question of lateral strength is one that enters largely into car design, and in this case was an important factor. A special section could be designed to use greater economy of steel, but spe-



Showing Construction of Bolster.

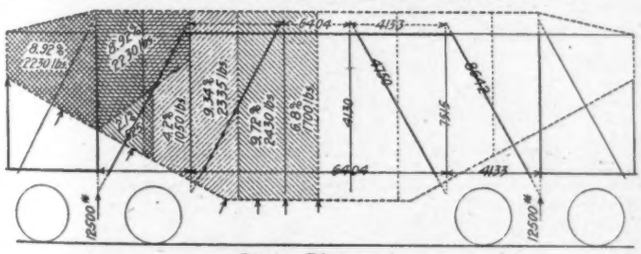
cial sections and odd sizes of material were considered very undesirable. The weight of the car is very satisfactory, notwithstanding this, weighing but 38,000 lbs., new, to carry over 74 per cent. revenue load. The test load of 112,000 lbs. produced a vertical deflection of but ⅛ in. at the center of the sides, measured between the bolsters, while the deflection of the center sills was 7/32 in.

The specifications of these cars are in the usual form, and include sections relative to the punching, rivets, etc., that are in conformity with those of the Manufacturers' Standard Specifications. The following is quoted as the language of the specification in regard to the painting of the steel frame and of the completed car:

Before riveting up all surfaces coming together shall be painted, and after the frames are riveted up and before any woodwork is attached they shall be cleaned and thoroughly painted with one coat of paint made as follows:

22 lbs. of dry red lead.
2 qts. of pure raw linseed oil.

This thick mixture must stand for a short time, and prior to using must be thinned with one quart of raw linseed oil and one-half pint of japan. This will make one gallon of paint.



Stress Diagram.

Heavy Lines Indicate Members in Compression.
Light " " " " Tension.
Dotted " " Divisions of Panel Lading.

The calculation includes the heap leveled off to 1 ft. above top of car. The weight of the truss is not considered because of large factor of safety.

Only such quantities as are necessary for immediate use shall be mixed, and in no case shall a red lead paint made from a paste red lead be used. Lampblack to the extent of five ounces to the gallon of paint may be added to the above formula to assist in modifying the rapid action of the lead on the oil, and to aid in holding the lead up, but in no case may any larger quantity or any other pigment be incorporated.

All joints and surfaces of wood coming against either wood or iron in the finished structure are to be given a heavy coat of paint. The painting of the completed car is to consist of two coats of Norfolk & Western standard hopper black, thinned with boiled linseed oil, the ironwork to receive the same paint. The stenciling is to be done with standard Norfolk & Western white paint. The cars are to be weighed and the light weight stenciled thereon.

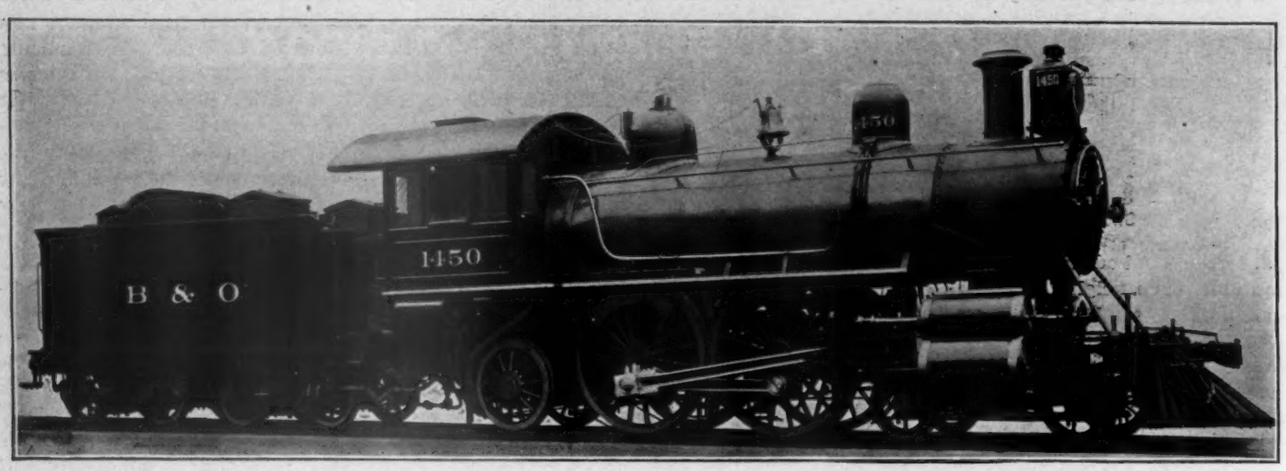
Mr. Cornelius Vanderbilt read an interesting paper on "Locomotive Boilers" before the junior members of the American Society of Mechanical Engineers, January 8, confining his remarks principally to the corrugated firebox boiler. This boiler, which was fully illustrated in the September, 1899, issue of this journal, has been applied to engines on the Baltimore & Ohio, Union Pacific and New York Central & Hudson River Railroads. Comparative evaporative tests of the Vanderbilt boiler show equally as good, and in some particulars better results, than the ordinary types of locomotive boilers. From Mr. Vanderbilt's remarks it is inferred that these engines thus far are satisfactory and that the corrugated firebox boiler has met the expectations of the designer.

The first of the four Chicago-European freight steamers now being built to ply between Chicago, Liverpool and Hamburg, was launched December 20. The "Northwestern," as she was christened, is 256 ft. long, 42 ft. beam and 26½ ft. deep. Her motive power will consist of a single screw operated by triple-expansion engines placed, together with the boilers, at the stern, so that the hold is not separated by the machinery, as is generally the case with ocean steamers, but placed entirely ahead, as in the design of lake steamers.

One of the two boiler tests to be made by the students taking the steam engineering course at the Massachusetts Institute of Technology is now well under way. The boilers on which the first test is made are 100 horse-power each, are 16 ft. long, 60 ins. in diameter and have eighty-four 3-in. tubes which are cleaned every twenty-four hours. Two of the four boilers have Hawley down-draught furnaces and two have Sheffield shaking grates. The duration of these tests will be ninety-six and eighty-eight hours respectively, and the result to be determined are: The chemical analysis of the coal and its heat of combustion, in British thermal units; the total evaporation from and at 212° F. per pound of dry coal, per pound of combustible and per square foot of heating surface per hour; also the coal burned per square foot of grate surface per hour. The boilers are rated in horse-power developed according to the American Society of Mechanical Engineers' standard.

The lightest electric storage batteries to-day store about 30,000 foot-pounds per pound; coal stores 10,000,000—of which, however, but about 10 per cent. is thermodynamically transformable—and heated water stores about a fiftieth of that figure. According to a writer in "Cassier's Magazine," the heavy storage batteries of the market, proportioned for durability, store but about 20,000 foot-pounds per pound weight. From one-third to one-half the total weight of the storage battery outfit, as commonly constructed, is acid, tank and lining. Both cell and accessories are undoubtedly to be greatly lightened with later improvement. The real question of interest to us now is to what extent we may be able to profit by such improvement in the early future. Just now we must reckon on a weight of not far from 70 per cent. as a maximum, of lead to cell-weight, and 60 to 70 lbs. of cell per hourse-power-hour, stored in a space measuring not far from 1 cu. ft. minimum, 1½ as a maximum, per horse-power-hour, although automobilists' demands have, in special cases, brought the space down to 1 cu. ft., and still less is promised. For similar quantities of power and work, at the point of application to propulsion, the storage battery has a weight of fifty to a hundred times as much as coal and demands from ten to twenty-five times as much space.

The reason why high train speeds are not heard of in Continental Europe is stated by Mr. Rous-Martin in the "Engineering Magazine" to be due to Government restrictions. In France speeds are also limited, but by maintaining high average speeds the trains of that country are wonderfully fast. Mr. Rous-Martin says: "All over Germany and Belgium, and, I believe, also in Holland and Austria-Hungary, the maximum speed is rigorously limited to about 56 miles per hour. I understand that a similar restriction exists on the East Railway of France and it also does—or did until very recently—on the French Western line. For a long time the Chemin de Fer du Nord stood alone in France in being permitted to run at 74.5 miles an hour, but this is now sanctioned also on the Orleans, Est and Midi lines. The Orleans Railway was limited to 70 miles an hour, up to a little more than a year ago, and the Paris-Lyons Mediteranee 62.1 miles an hour. I believe that on the latter railway this limit has lately been extended, and on the Nord line a speed of 77.6 miles may be run on special occasions by direct permission. But the principle of restriction holds good over the entire European continent."



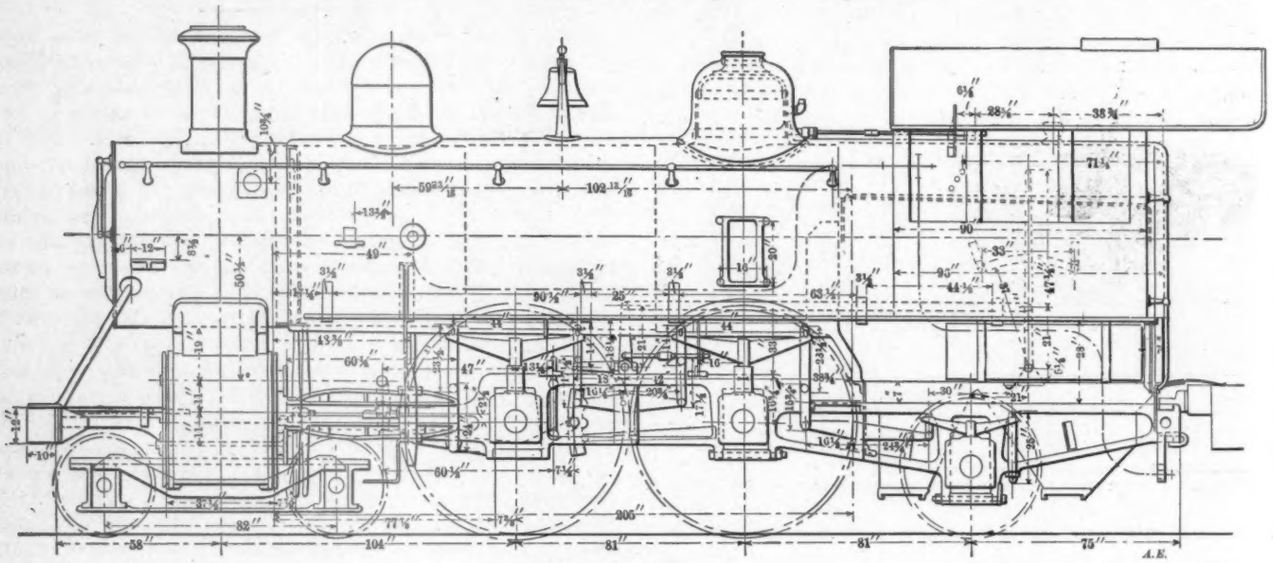
COMPOUND "ATLANTIC TYPE" PASSENGER LOCOMOTIVE, WITH WIDE FIREBOX—BALTIMORE & OHIO RAILROAD.

J. N. BARR, *Mechanical Superintendent.* BALDWIN LOCOMOTIVE WORKS, *Builders.*

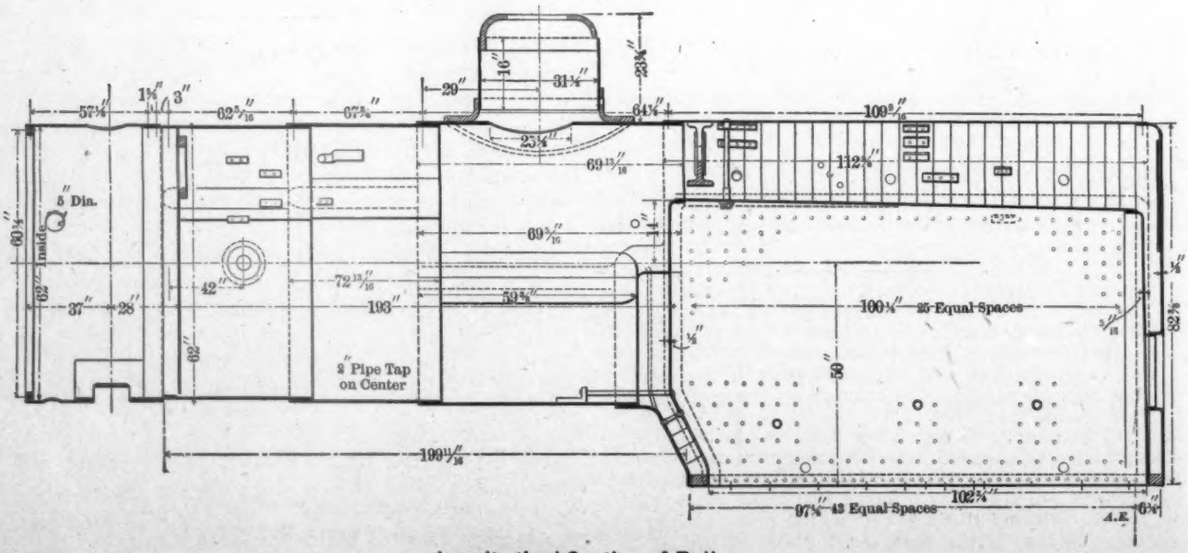
Cylinders: 15 and 25 x 28 in. Boiler pressure.....200 lbs.

Wheels: Driving	78 in.;	engine truck	33 in.;	trailing wheels	48 in.; tender wheels 36 in.
Weights: Total of engine	142,600 lbs.;	on drivers	83,400 lbs.;	total engine and tender	249,000 lbs.
Grate area and tubes: Grate area	42.5 sq. ft.	Tubes			300; 2 in., 16 ft. 1 in. long.
Firebox: Length	112 in.;	width	60 in.;	depth of front	64 in.; back 62 in.
Boiler: type, straight		radial staying.		Diameter	62 in.
Heating surface. Tubes	2,513 sq. ft.;	firebox	150 sq. ft.;	total	2,663 sq. ft.
Wheel base: Driving	6 ft. 9 in.;	total of engine	25 ft. 7 in.;	engine and tender	52 ft. 6½ in.

Tender: Eight-wheel; water capacity.....5,000 gals.; coal capacity.....8 tons.



Side Elevation.



Longitudinal Section of Boiler.

COMPOUND "ATLANTIC" TYPE PASSENGER LOCOMOTIVE.

With Wide Firebox.

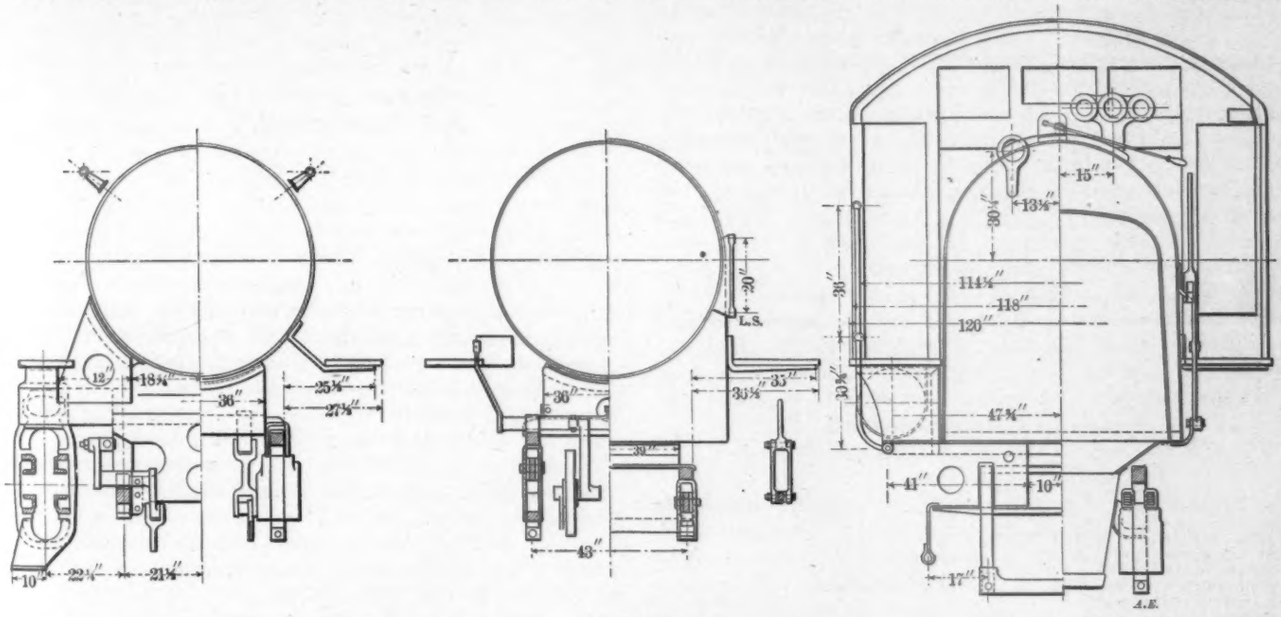
Baltimore & Ohio Railroad.

The adoption of the wide firebox for burning soft coal by the Baltimore & Ohio is interesting from the fact that this road has had a long and extensive experience with large grate areas for hard coal. This design is particularly noteworthy also because of the combination of wide grates and compound cylinders with the "Atlantic" type of wheel arrangement. It should prove altogether favorable and reports indicate that the expectations are being realized. With a total weight of not quite 150,000 lbs. the total heating surface is 2,663 sq. ft., which is almost the same as that of the 10-wheel locomotives of the Great Northern Railway built in 1898 which weigh 166,000 lbs. The Baltimore & Ohio engine has more heating surface for its weight than any design of this type of which we have record, and this indicates a successful effort to save weight elsewhere in order to increase the boiler capacity.

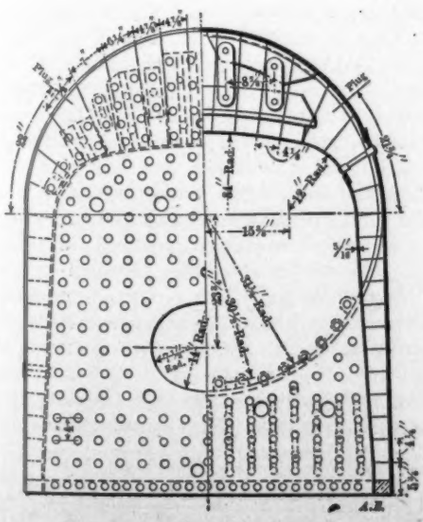
Our engravings illustrate the end elevation and sections, the boiler and firebox, the low-pressure piston and hollow piston rod, the perforated pipe valve yoke, upon the end of which a relief valve is mounted, and the piston valve with L-shaped rings. The dimensioned drawings and the following table render an extended description unnecessary:

General Dimensions.

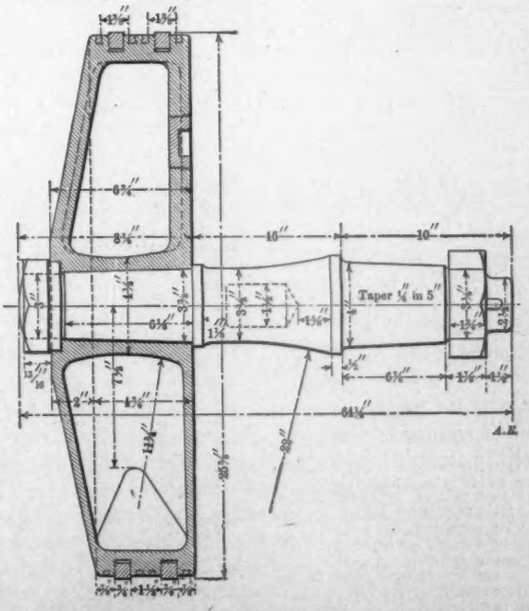
Fuel	Soft coal
Cylinders	15 and 25 by 28 ins.
Driving wheels, diameter	78 ins.
Wheel base, total of engine	25 ft. 7 ins.
Wheel base, driving	6 ft. 9 ins.
Wheel base, total (engine and tender)	52 ft. 6½ ins.
Length over all, engine	40 ft. 5 ins.
Length over all, total, engine and tender	62 ft. 6½ ins.
Height center of boiler above rails	8 ft. 7 ins.
Height of stack above rails	14 ft. 6½ ins.
Weight on drivers	83,400 lbs.
Weight on truck wheels	37,940 lbs.
Weight on trailing wheels	28,260 lbs.
Weight, total	149,600 lbs.
Weight tender, loaded, about	100,000 lbs.
Heating surface, firebox	150 sq. ft.
Heating surface, tubes	2,513 sq. ft.
Heating surface, total	2,663 sq. ft.
Grate area	42.5 sq. ft.
Truck wheels, diameter	33 ins.
Journals, driving axle	8½ x 12 ins.
Journals, truck axle	5½ x 10 ins.



Sections and End Elevations.

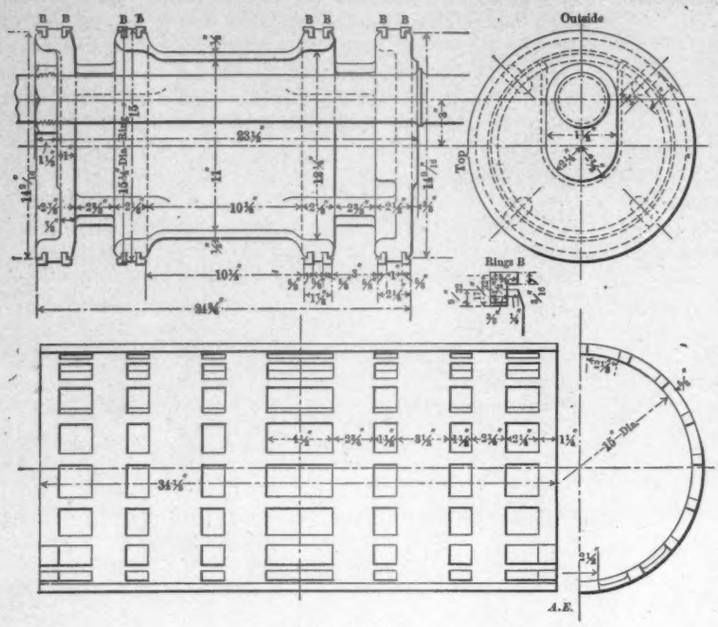


Transverse Section of Firebox.

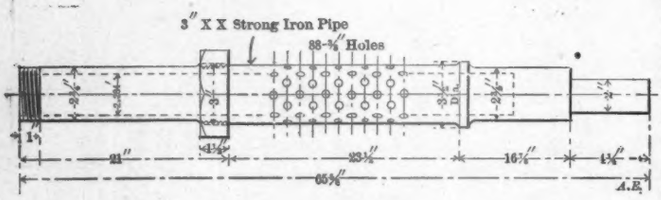


Low Pressure Piston and Hollow Piston Rod.

Compound "Atlantic Type" Passenger Locomotive—Baltimore & Ohio Railroad.



Piston Valve.



Perforated Pipe Valve Yoke.

Main crank pin	6½ x 6½ ins.
Piston rod, diameter	3½ ins.
Main rod, length center to center	10 ft. 9⅝ ins.
Steam ports, length	34 ins.
Steam ports, width	1½ ins.
Exhaust ports, length	34 ins.
Exhaust ports, width	4½ ins.
Bridge, width	3½ and 2¾ ins.
Valves, kind of	Piston
Valves, greatest travel	5½ ins.
Valves, outside lap	H. P., ⅞ in., L. P., ⅝ in.
Valves, inside, clearance	H. P., ⅛ in., L. P., ¼ in.
Valves, lead in full gear	H. P., 0, L. P., ⅛ in.
Boiler, working steam pressure	200 lbs.
Boiler, thickness of material in barrel	11/16 and ⅝ in.
Thickness of tube sheets	½ in.
Thickness of crown sheet	⅜ in.
Crown sheet stayed with	Radial stays
Dome, diameter	31½ ins.
Firebox, length	8 ft. 5 15/16 ins.
Firebox, width	5 ft. ½ in.
Firebox, depth front	64 ins.
Firebox, depth back	62 ins.
Firebox, thickness of sheets	5/16 in.
Firebox, water space, width	Front 4 ins., sides 3 ins., back 3 ins.
Tubes, number	300
Tubes, outside diameter	2 ins.
Tubes, length over sheets	16 ft. 1 in.
Smokebox, diameter	63 ins.
Smokebox, length	65 ins.
Exhaust nozzle	Double
Netting, size of mesh or perforation	2½ x 2½ ins.
Stack	Straight
Stack, diameter	18 ins.

Tender.

Type	Eight-wheel
Tank capacity for water	5,000 gallons
Coal capacity	8 tons
Type of underframe	Wood
Type of truck	Barber
Type of truck spring	Elliptic
Diameter of truck wheels	36 ins.
Diameter and length of axle journals	5 x 9 ins.
Distance between centers of journals	76 ins.
Diameter of wheel fit on axle	6⅜ ins.
Diameter of center of axle	5⅜ ins.
Type of truck bolster	Barber
Length of tender frame over bumpers	22 ft. 2 ins.
Length of tank	20 ft.
Width of tank	8 ft. 8 ins.
Height of tank, not including collar	5 ft. 5 ins.
Height of tank over collar	6 ft. 1 in.

LIQUID FUEL.

This subject has recently come afresh before the French Society of Civil Engineers with special reference to the establishment of supply stations for ships of war. The Institution of Civil Engineers presents the following abstract of a paper by Mr. H. Guerin in "Genie Civil":

Evidence exists of the increased use of liquid fuel in British vessels trading in the Far East, the installation of a charging station at Suez having been authorized by the Egyptian Government, and for railway and other purposes in Russia, America and other countries. The author refers to articles in Vols. xxxiv., xx., xxiv., viii., xxi., xxxv. and xxxvi. of the "Genie Civil," and to a paper in the "Engineering and Mining Journal" of New York, by H. Tweddle, which describes the best methods of using this fuel and of which this article is to some extent a resume. The best results have been obtained by the use of crude petroleum.

The proportions of carbon, hydrogen and oxygen in various hydrocarbons and their calorific power (in calories per kilogram) are given in the following table:

	C.	H.	O.	Calorific power.
Light petroleum oil—American	86.894	13.107	.....	10,913
Refined	85.491	14.216	0.293	11,047
Petroleum spirit	80.583	15.101	4.316	11,086
Crude petroleum	83.012	13.889	3.099	11,094
Light oil from Baku	86.700	12.944	.....	10,843
Petroleum from the Caucasus	84.906	11.636	.....	10,328
Ozokerite from Boryslaw	83.510	14.440	.....	11,163

To realize the theoretical calorific power and the highest temperature of combustion it is necessary to supply to the combustible the exact quantity of air furnishing the necessary amount of oxygen, and to have the most intimate possible contact between the air and the fuel. Consequently gaseous fuel offers the best conditions for obtaining the best result, liquid fuel the next, and powdered solid fuel the next in order, although in practice excess of air, deposits of soot and other causes prevent more than a moiety of the useful effect being realized, especially in the case of coal firing. The methods of using fuel in the liquid form are, however, the most simple of all, and hence the repeated efforts toward a more general introduction of this kind of fuel.

Various forms of injectors or "pulverizers," which have been from time to time proposed and introduced, are enumerated by the author, and the effects of different forms of jets on the completeness of the pulverization of the oil and its admixture with the air are discussed. The most suitable form of flame for a given furnace or process depends upon the quality of the oil and on the purpose to which the heat of combustion is to be applied.

Tweddle has found by experiment that in order to obtain the highest possible temperature from liquid fuel it is necessary to burn it in fire-brick combustion chambers of limited capacity, and that for evaporative effects an injector worked by steam is preferable to one using an air-jet, which is more suitable for reheating, forge and other furnaces of that class. The author introduced the use of petroleum fuel on the Oroya Railway in Peru in the year 1890, where experiments had to be conducted under unfavorable conditions. Starting from sea-level at Callao, the railway crosses the Andes at an altitude of 4,250 meters, with a total length of about 160 kilometers. The gradients and curves are consequently against the realization of a high duty. Nevertheless, the consumption of oil was little over half that of coal for the same work, although the calorific power of the oil as compared with that of coal was only as 1.4 is to 1.

Mr. Charles T. Schoen has resigned from the presidency of the Pressed Steel Car Company, and Mr. F. N. Hoffstot, of Pittsburg, has been elected to succeed him. Mr. Hoffstot has been a director in the company since its incorporation.

A NEW METHOD OF TONNAGE RATING IN FREIGHT SERVICE.

In October last the Canadian Pacific Railway put into effect a new method of tonnage rating which seems to be successful in the application of a new idea based upon the fact that the resistance per ton of loaded cars is less than of empty ones. Mr. Thomas Tait, General Manager of the road, described the plan in a paper read at the January meeting of the New York Railroad Club which should be studied by our readers who are engaged upon this problem. Probably the secretary can furnish copies.

This plan goes much farther than to reckon cars as empty or loaded; it takes into account the proportion of load to tare, the variation having greatly increased of late through the introduction of cars of large capacity. Experience on this road has demonstrated:

First—That the haulage capacity of engines from station to station in each direction should be based on a uniform proportion of tare weight to gross weight behind the tender.

Second—That in loading engines the resistance of every train, as compared with that of a train having this uniform proportion of tare, should be determined.

After investigating it was decided to adopt one-third (two tons of contents to one ton of tare weight), as the uniform proportion of tare weight to gross weight behind the tender to be used in the new schedules of haulage capacity in freight train service. These schedules of haulage capacity of locomotives in freight train service show the number of tons which each class of engine can take from station to station in each direction in a train, the tare weight of which is one-third the gross weight behind the tender.

The locomotives are classified according to their hauling capacity, each class being designated by its percentage of haulage capacity—the standard ten-wheel freight engines being termed "100 per cent." engines; more powerful engines, "140 per cent.," "150 per cent.," etc.; lighter engines, "60 per cent.," "65 per cent.," etc. Five per cent. of haulage capacity represents approximately a drawbar pull of 1,000 lbs. at seven miles per hour, which is the speed over grade summits on which the haulage capacity of engines has been based. The drawbar pull which any engine can exert is thus easily ascertained if its percentage of haulage capacity is known, or vice versa. In these schedules the ruling grade on each section is clearly indicated, as is also the increased tonnage (passing load), if any, which can be taken if the train does not stop at a station.

The capacities of the engines were carefully determined by a dynamometer car and other schedules were prepared for use in making up trains. These contain figures which permit of accurately loading an engine, when the hauling capacity is known, so that the exact amount of tonnage for a train may be selected, the weights of cars and their loads being known. The schedules are compiled on the basis that empty cars require 30 per cent. more power than the same tonnage in fully loaded cars. The load, as shown by this chart, is termed "equivalent tonnage," it is not the "actual tonnage" in the sense of being the actual weight of the cars and loads.

In the use of the system allowances are made for speeds, various conditions of weather and rails. The experience of the Canadian Pacific seems to indicate the value of the system, and while at first glance it appears rather complicated, the author of the paper states that it is really not so and that the results already obtained warrant still further extension of it.

The steam turbine has made considerable progress in Continental Europe. We are told by the "Mechanical Engineer" that in Sweden, where the Laval turbine originated, there are 1,000 in use. The French Laval Company has sold 600 since 1894, and they are used in positions of responsibility in French naval vessels and in other government service.

PENSION SYSTEM.

Chicago & Northwestern Railway.

A system of pensioning the employes of the Chicago & Northwestern Railway Company was put into effect January 1, 1901, by the new Pension Board of that road. The rules adopted affect two classes of employees in the service of the company. Those who have reached the age of seventy years and have been in service thirty years are to be retired and pensioned, and those having acquired the age of sixty-five to sixty-nine years and have become incapacitated, may be retired and pensioned after thirty or more years of service. This applies to employees of all the roads owned or controlled by the Chicago & Northwestern. The length of service will be reckoned from the date of entering the service of these roads either before or after the control or acquisition by the Chicago & Northwestern, and the amount given will be for each year of service, 1 per cent. of the average monthly pay for the ten years preceding retirement, and will be paid monthly until the death of the recipient of the pension. Should the aggregate allowance for this purpose exceed $200,000, a new rate will be established proportionately reducing the allowances. Hereafter persons over thirty-five years of age will not be taken into the service of the company, unless for some service requiring professional and special qualifications, and then it must be only upon the approval of the Board of Directors. Those having been retired on the pension allowance are not hindered from engaging in other business if it is not detrimental to the interests of the company. For comparison with the Pennsylvania system of pensioning our readers are referred to page 295 of the volume of this paper for 1899, where a description of that system is given. These plans for caring for aged employees cannot fail to improve the relations between the road and its men, and it is hoped that the idea will spread and become a fixed principle among American railroads.

COST OF OPERATING COMPRESSED AIR CARS.

The accompany figures, which appeared in the January issue of "Compressed Air," are the running expenses of 20 compressed-air cars during a period of 47 days on the 28th and 29th street air lines, New York:

Summary.

Total round trips	17,197
Total mileage	94,583.5
Total passengers carried	1,017,269
Average number of passengers per trip	59.15
Average number cars running	17.5
Average number daily trips per car	17.2
Average number miles per day per car	94.6

The following total cost of operating these 20 compressed-air cars, under present conditions, is computed on a basis of 1,750 miles per day:

	Cents per car mile.
Repairs: Including material, supervision, and nine men, adjusting valves, piping brakes, rods, brasses, labor, etc., $35 per day	2.
Charging Station: Including oil, waste, foreman, charging gang (two shifts), oilers, cleaners, etc., $28 per day	1.60
Power House: Including engineers, coal passers, pipe fitter, machinist, oilers, etc., and 16 tons coal per day, oil, waste, etc., $82.50 per day	4.71
Cents per car mile	8.31
Conductors and motormen, inspectors, roadbed, ties and timber, removing snow, salaries of officers, switches, material, etc.	9.11
Cents per car mile	17.42

These cars are not operated under the most favorable circumstances, as the charging and power plant has a capacity for 60 or 80 cars, and would, if running more nearly its capacity, reduce considerably the cost of operation. The Compressed Air Company estimate this cost at 13.57 cents per car mile under uniform conditions. These figures compare very closely with those of the electric system with a greatly cheapened roadbed in favor of the compressed-air service.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

The paper may be obtained and subscriptions for it sent to the following agencies: **Chicago,** *Post Office News Co., 217 Dearborn Street.* **London, Eng.,** *Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.*

Progress in the development of the gas engine is clearly indicated in a comparison of the last two international expositions. In 1893, at the World's Fair in Chicago, the largest gas engine was one of 35 horse-power, while at Paris the largest was rated at 1,000 horse-power, and this engine had but a single cylinder. Blast-furnace gas has been used extensively in Belgium for running gas engines, the power for blowing the furnaces and for other purposes being supplied from what was previously a waste product. The Pennsylvania Steel Company are preparing to develop this idea at their works at Steelton, and it will without doubt exert a marked effect upon gas-engine practice in this country. The use of gas engines is increasing as their advantages are better known and understood; almost all types are made to use oil as well as gas, and with the advent of small, easily-managed gas producers, the internal-combustion engine is made available for many purposes as the most convenient and the cheapest power producer. The oil or gasolene engine is specially attractive for a great deal of intermittent work, such as operating turntables, transfer tables, ash and coal hoists, running shears and punches in places where it is not convenient to carry wires or pipes. It is making its way on its merits, but appreciation seems to grow rather slowly. No new shop plan should be prepared without at least a careful consideration of the gas engine. There are reasons for belief that a satisfactory double-acting cut-off-governing gas engine is at hand, at least Mr. C. E. Sargent's recent paper before the American Society of Mechanical Engineers gives hope of such an attainment, and altogether the gas-engine subject seems to be gaining ground in a promising and practical way.

In European steam engine practice the sight feed lubricator, so generally used in this country, has given place to the simple force-pump method of distributing oil, particularly in cases where the oil must be delivered against steam pressure. Experiments which are now under way in the west seem to indicate very promising results with the same idea when applied to locomotives for the lubrication of valves. With a small pump worked from the valve stem a positive and properly regulated feed is obtained, with the certainty that the oil gets to the valve and that it gets there at once. This experiment may lead to the use of a rather substantial little oil pump with feeding tubes running to the piston rod and valve stem packing as well as the top of the steam chest.

Locomotives are often classified, for tonnage rating, in proportion to their tractive power. The unit chosen for the 100 per cent. rating may be any engine, even if not by any means the one of greatest power, and we occasionally hear of engines of 140 and 160 per cent., and from these down to 50 per cent. In this connection a correspondent recently offered a thoughtful suggestion that the most powerful engine on the road should be rated at 100 per cent. and the others would often range down even to 28 per cent. He considered it important to change the number with each increase in capacity brought in by new locomotives, always considering the most powerful as the 100 per cent. engine. His object is to emphasize the weakness of the small and light engines by designating them as 28 or 25 per cent., and thus bring them into such prominence for their inadequacy that it will be easier to get rid of them. This appears to be an excellent suggestion. It is probable that it will pay to change the number with each improvement rather than to be handicapped by a lot of inefficient engines.

Successful management of important enterprises of all kinds involves the direction of the abilities of subordinates and those who accomplish most owe most to the work of others. Their secret is in their knowledge of men and the appointment of the right man for each part of the work. The complete idea is expressed by "organization." It involves the discovery of special ability of all kinds and, necessarily, a knowledge of the available men. No success can be permanent which does not provide for the advancement of worthy men already in the service, because, with the rank and file discouraged by the continued policy of importing superiors, the ultimate efficiency must suffer. The managing officer of one of the large locomotive works recently made an appointment which seems right and wise. A man was wanted for some specially important work in the shop which required familiarity with the methods in vogue and made it desirable to select one already in the employ of the company. A record of the experience of every young man in the plant, including the drawing room, was taken. This had never been done before and it revealed a large amount of experience which was not known or expected, the result being that exactly the experience desired was discovered in one of the draftsmen. This man was a loss in the drawing room, but he was saved from the death of a draftsman, the special work was well done and the atmosphere of the drafting room changed with the improved prospects of that department. Managers who appreciate this policy will never lack efficient subordinates and they will seldom if ever need to go outside of their own organization for even the most important and responsible assistants. Railroad presidents and heads of departments can not afford to be too busy to think of these things.

The study of conditions of combustion in locomotive fireboxes recorded by Mr. A. Bement in our November number emphasizes the importance of intelligent design and careful use of ash-pan dampers for the control of air admission below the fire. The ease and convenience with which the composition of fine gases may be continuously observed by aid of modern apparatus should lead to a great increase of interest in the subject of combustion which is one worthy of the best thought.

Additional air supply above the fire is required, especially by large engines with relatively small grates, and it may be had by leaving the fire door partially open, the amount being determined by experiment. But there is danger of overdoing in the direction of air supply with the enlargement of grates and this is a good reason for considering the gas analysis method of studying the action of the firebox. The suggestion of this method by Mr. Bement should be carefully considered. While this is a period of unusual activity in locomotive development, it is a time for caution and intelligence. The wide grate is bound to come out right in the end, but the study of the relations between certain coals and certain grates will be greatly facilitated by gas analysis work which is now possible to conduct by aid of the testing plant.

Air admission is important in the round-house as well as on the road. At many terminals fires are banked without reference to the fact that there is a right and wrong way. On many roads the hard service keeps the round-house forces unusually busy with tube leakage and kindred troubles, and this is sure to develop weakness in round-house practice where it exists. Tubes suffer severely when the fires are banked at the back end of the firebox if the front damper is left open. It is important to bank fires at the front end and keep the dampers closed in order to prevent the cold air from pouring through the tubes as will occur in the other practice. It is also advisable to place tight dampers in the smoke jacks of round-houses where the jacks are made to be drawn down to fit the stacks or to cover the stacks with a board or other tight cover while the engine is standing in the round-house with the fire banked. This occasions very little inconvenience, and it seems to be thoroughly worth while.

LOCALIZED DEFLECTIONS IN BUILT-UP STRUCTURES.

The real strength of an engineering structure is its ability to withstand continuous service without undue deflection or fracture, and is not necessarily measured by the greatest single load which it will safely carry. Sometimes the real strength may be increased by a decrease in what may be called the apparent strength. For example, a piston rod, subject to slight bending, may be actually strengthened by weakening it to permit it to adapt itself to the bending. Deflection cannot safely be disregarded, and this is specially true of composite or built-up structures. In some kinds of designing, as in machine tools, deflection must be absolutely prevented, but in general it may be said that good engineering consists in the use of sufficient material to permit of safe deflections and in the distribution of the material in such a way as to prevent the localization of the movements. In built-up structures this localization is most likely to occur, and is most difficult to manage. Locomotive frames and metal trucks for heavy freight cars are good examples of this. In the former mere size of the section will not always suffice, because the improvement of the cylinder attachments to the frames and a general stiffening up of the front ends may localize the service flexure at some point in the rear and cause breakage in a frame which is ample to meet static loads and shocks. In metal car trucks there is a strong temptation toward excessive rigidity in the connections between the side frames and the transoms. These structures must necessarily deflect to some extent, and if the joint is made stiff the deformation is likely to localize in this case in the transom, near the joint, and result ultimately in fracture. Those of our readers who have seen the pile of broken trucks which inspired these comments already appreciate the point we make, and to others this suggestion is offered: that the localizing of deflection must be guarded against in designs of this kind. All this may also be said of boilers, in which the increase of pressures has brought about new conditions which were not important or did not exist at all in the days of lower pressures. The concentration of stresses in boilers is most noticeable in the deformation caused by the attachment of the angle braces for the back heads and for tube sheets. These braces are sometimes short, the feet attachments to the plates small in area, and the angle of pull such as to draw down the outside sheets locally. In back-head bracing this may cause the crown stays of a radial firebox to leak and it may open the seam near which the front braces are secured. These, while not serious, are important in that they indicate a direction for thought in designing. Flexibility must be provided where it is needed, and it is usually necessary to distribute the flexure in order to prevent it from occurring within too small a space.

CAST IRON WHEELS FOR HEAVY COAL CARS.

Present experience with coal and ore cars of large capacity seems to indicate that the limit of the cast iron wheel has been reached, unless a change in form is made or the wheel flanges are in some way relieved in service. The breakage of wheels, and particularly of flanges, under 50-ton cars has created a great deal of anxiety of late, and the question of the necessity for steel-tired wheels for this service is now seriously raised. It has been said that the cars are too heavy and that there will be a general reduction from 50 tons to 40 tons as the maximum capacity. This probably will not be done as long as railroad managements are able to obtain the benefits of 50-ton loads in one or both directions in cars making an average of 2,000 to 2,600 total miles per month, which is now being done. There seems to be no question of the firm establishment of the 50-ton car, and the wheels must be made to carry them. Cast iron wheels for these cars have been strengthened at the hub to the point of withstanding a wheel press pressure of 110 tons upon a mandrel, and they have, in at least one case, been increased in weight to 690 lbs. for the purpose of overcoming breakages in the plates, but the breakage of flanges is not so easy to stop. The opinion that the limits of strength of the flanges of cast iron wheels of the present standard contour has been reached is growing among those having the widest experience with these cars. It seems to be necessary to increase the thickness of the flange as it stood before 1894 or to take up the steel-tired wheel. Perhaps ⅛ in. more metal in the thickness of the flange will be enough. It is, of course, desirable on account of the low cost to make the cast-iron wheel strong enough, and efforts will be made in that direction. This question will undoubtedly receive attention at the convention next summer, but instead of being confined to engine trucks the relative safety of the two types of wheel needs to be considered also from the standpoint of cars. Several broken flanges coming to our notice had blue fractures showing the influence of the brakes on mountain grades. This is troublesome in the East as well as in the West. It is evident that the near approach to 75 tons of car and load, brings up new factors in the matter of wheels. It occurs to us that perhaps the general use of rigid trucks has a bearing upon the flange breakage and the suggestion of a return to the swing motion truck for such heavy cars seems to be a reasonable one. It would undoubtedly serve to reduce the shocks to which rigid trucks must necessarily subject the wheel flanges.

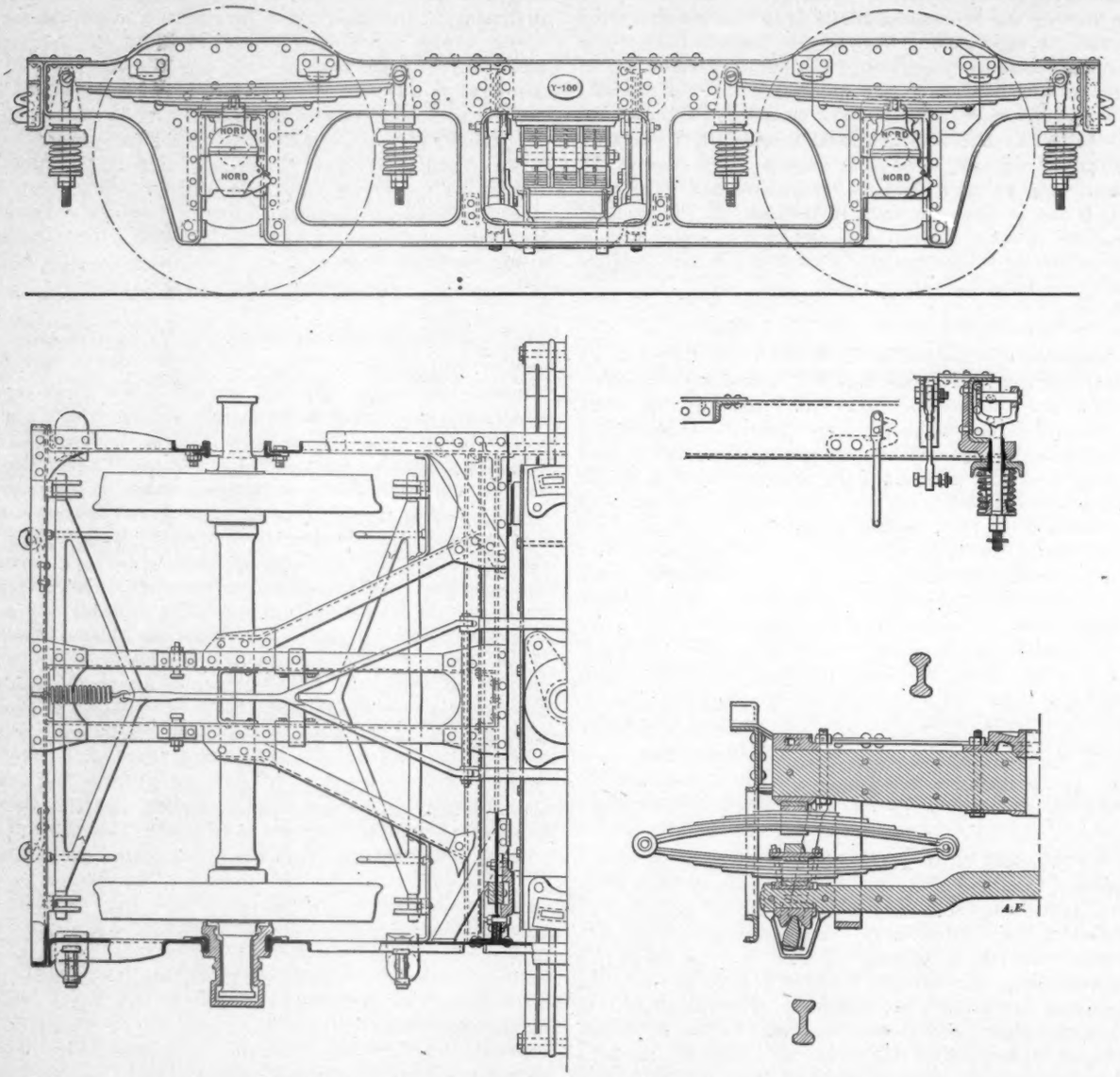
STEEL FRAME PASSENGER TRUCK,

With Springs Over Journal Boxes.

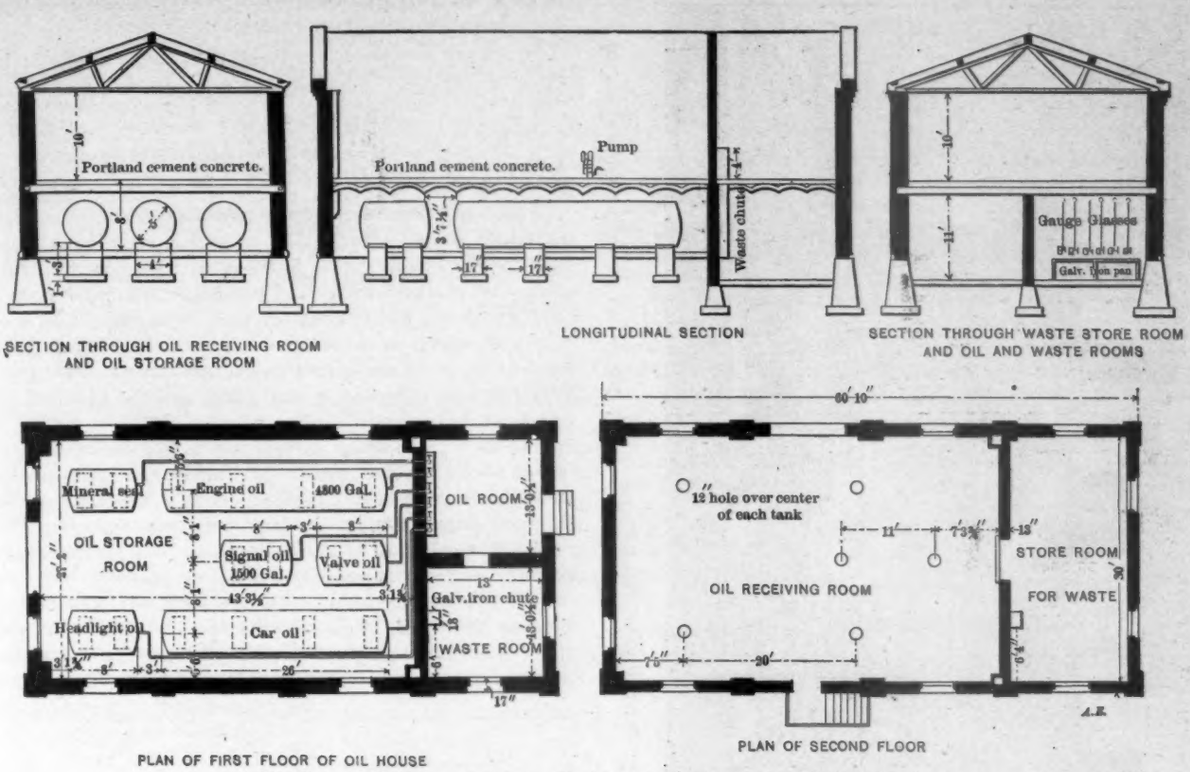
In response to a request for information concerning the spring suspension of four-wheel trucks on foreign roads the accompanying engravings, illustrating a recent design by the Chemin de Fer du Nord, have been prepared. Several American roads are investigating the passenger truck question, hoping to be able to substitute a four for a six-wheel design for heavy cars, the object being to save weight and expense. Thus far the designs of four-wheel trucks for this purpose (American Engineer, October, 1900, page 306, and January, 1901, page 12) have employed the usual form of equalizers, and if the fear that the good riding qualities of the six-wheel trucks are to be sacrificed is well founded, this French design with long springs over the journal boxes will be suggestive. It serves to raise the question whether the equalizer is necessary with present conditions of trucks, and it appears to be worth while to consider an adaptation of this form of spring suspension to American conditions for a trial at least. If the springs over the boxes are made long enough the riding qualities should be satisfactory. The Swiss truck, a sketch of which was shown on page 290 of our September number last year, is in use under cars weighing 75,000 lbs. We do not know the weight of the French cars to which the present engravings apply, but would guess about 70,000 lbs.

This French truck, with a wheel base of 8 ft. 2½ ins., has pressed steel side frames, ⅜ in. thick, with pressed channel end sills 5/16 in. thick and I-beam transoms. Gussets are plentiful and the frame has longitudinals and diagonals for additional stiffening. The fastening appears to be altogether by rivets.

The spring suspension is made clear by the engravings. The track bolster, swing links, and elliptic springs on the sand plank are not far different from our practice, except as to the details which are elaborately worked out in the original drawings. The links are inclined, approaching each other at the top ends, which may be criticised, but it is to the springs over the boxes that attention is specially attracted. Four long, flat springs bear on the boxes, and these support the frame by means of hangers supplied with coiled "Timmis" springs at their ends. The hangers are forked at their upper ends, and the load is carried to the coil springs by means of bronze sleeves, giving essentially a ball and socket connection. A uniform flexibility of the springs was sought for, in order to secure isochronal vibrations and render the oscillations uniform and easy. The dampening action of the leaf springs appears to be another important factor in this truck, and this is specially worthy of attention. The whole effect desired was that which would make the suspension of the car correspond to that of a hammock as far as the horizontal reactions are concerned.



Steel Frame Passenger Truck with Leaf Springs Over the Journals.



Oil House, Chicago, Indianapolis & Louisville Railway Lafayette, Ind.

A CONVENIENT OIL HOUSE.

Chicago, Indianapolis & Louisville Railway.

We have lately received several inquiries concerning the construction of oil houses from officers who are engaged in arranging plans for new shops, and the tendency seems to be to secure a plan which will permit of handling the oil to as great an extent as possible by gravity. An excellent system, which has been in use for a number of years at the Lafayette shops of the Chicago, Indianapolis & Louisville, the "Monon Route," is illustrated in the accompanying engraving made from a drawing especially prepared for us by Mr. H. Monkhouse, Superintendent of Motive Power of that road.

The merit of the plan is in the use of gravity flow for handling the oil throughout, although the operation of unloading from tank cars may be facilitated by air pressure when desired. The oil tank cars are received upon an elevated trestle along one side of the building, and oil may also be delivered in barrels from cars on this trestle. The tank cars unload direct to the storage tanks in the basement of the building, and barrels may be rolled into the second story and their contents dropped into the tanks through 12-in. holes in the floor, one of these being located over the center of each of the storage tanks. The storage tanks are all piped to the oil-delivery room, and the pipes terminate over a large pan, each pipe having a gate valve and a gauge glass to show the level of the oil in the corresponding tank. The floor of the oil delivery room is 3 ft. below that of the storage room.

The second story also provides for the storage of waste, which is delivered to the waste room below through a vertical chute. The floors are all of concrete, the roof is steel, and there is nothing about the building which will burn, except the oil and waste. In the second story a pneumatic oil pump is provided for filling barrels with oil from the main storage tanks, for use in shipping barrel lots to other points on the road. With this arrangement there is no necessity for cranes, and the oil house may be cared for by one man.

We acknowledge the courtesy of Mr. Monkhouse.

LOCOMOTIVE TRUCK BRAKES.

That long distances in which to stop trains are dangerous and expensive is being appreciated more and more by railroads nowadays, and much attention is given to increasing the tractive effort of locomotives, by increasing the weight and adding extra driving wheels, and by the use of traction increasers, to get trains out of the stations and over the road in a hurry. It therefore seems all the more necessary that absolute control be had over such trains by the application of the highest possible braking power to every wheel. In a recent bulletin issued by the Westinghouse Air Brake Company the proportion of available braking weight carried by the locomotive truck, under prevailing practice, was given as follows:

For a two-car train, about 15 per cent.
For a three-car train, about 12 per cent.
For a four-car train, about 10½ per cent.
For a five-car train, about 9 per cent.
For a six-car train, about 8 per cent.

To increase the braking power of a 6-car train nearly 8 per cent. by truck brakes, means that we are able to lessen the distance about 1/12 that ordinarily required for stopping the train. This is worth consideration for the same reason that high acceleration is advantageous as a factor in the saving of fuel, because the maximum speed to be maintained between stops in order to make schedule time is lower. A high rate of retardation must also decrease the possibilities of damage to property and loss of life. This is not only true of through passenger and suburban service, but of fast freight service, particularly on roads with steep grades. Inasmuch as it is often the last few feet that count most in a collision, the truck brake should not be neglected.

Charles L. Gately, Manager of the Railroad Department of the New York Belting and Packing Company, recently resigned that position to become Manager of the Railroad Department of the Manhattan Rubber Manufacturing Company, with office at 18 Vesey street, New York City.

BALDWIN LOCOMOTIVE WORKS, *Builders.*

Heavy Ten-Wheel Compound Passenger Locomotive—Union Pacific Railway.

J. H. McCONNELL, *Superintendent Motive Power.*

HEAVY 10-WHEEL COMPOUND PASSENGER LOCOMOTIVE.

Union Pacific Railway.

Built by the Baldwin Locomotive Works.

Last month we described the new Vauclain compound, consolidation freight locomotives, of which sixty have just been built for the Union Pacific Railway, and we now illustrate one of twenty 10-wheel compound passenger engines for the same road which are the heaviest of their type ever built and very nearly as heavy as the freight engines. They weigh but 1,080 lbs. less than the consolidation engines and in heating surface have not been exceeded by any engines of the 10-wheel type of which we have record.

With this great boiler power combined with compound cylinders these engines will unquestionably greatly reduce the amount of double-heading which strong winds, long grades and severe weather conditions have rendered necessary on this road. The engines seem to have the characteristics of the Baldwin design throughout, which was probably done to give them every advantage in the first use of the compound principle on this road. Ten of these engines have 69-in. and the other ten 72-in. driving wheels. The leading dimensions of three recent 10-wheel engines are interesting for comparison.

Comparison of Large Ten-Wheel Locomotives.

Road	Lake Shore.	D., L. & W.	U. P.
Builder	Brooks.	Brooks.	Baldwin.
Weight on drivers	133,000 lbs.	137,000 lbs.	142,000 lbs.
Total weight	171,800 lbs.	179,000 lbs.	184,240 lbs.
Drivers	80 ins.	69¾ ins.	69 and 72 ins.
Cylinders	20 x 28 ins.	20 x 28 ins.	15½ and 26 x 28 ins
Heating surface	2,917 sq. ft.	2,700 sq. ft.	3,011 sq. ft.
Grate area	33.6 sq. ft.	84.2 sq. ft.	32 sq. ft.
Reference to American Engineer	Nov., 1899, page 343.	Sept., 1900. page 272.	Present issue.

The following additional information concerning the Union Pacific engines, together with the photograph, are presented by courtesy of the builders:

Vauclain Ten-Wheel Compound Passenger Locomotives.

Union Pacific Railroad.

Gauge ..... 4 ft. 8½ ins.
Fuel ..... Soft coal
Weight on driving wheels ..... 142,440 lbs.
Weight on truck wheels ..... 41,800 lbs.
Weight, total ..... 184,240 lbs.
Wheel base, total, of engine ..... 26 ft. 9 ins.
Wheel base, driving ..... 14 ft. 6 ins.
Wheel base, total engine and tender ..... 54 ft. 0 ins.
Height center of boiler above rail with 72-in. drivers ..... 106¾ ins.
Height center of boiler above rail with 69-in. drivers ..... 105¼ ins.
Height of stack above rail with 72-in. drivers ..... 15 ft. 3 ins.
Height of stack above rail with 69-in. drivers ..... 15 ft. 1½ ins.
Heating surface, firebox ..... 186 sq. ft.
Heating surface, tubes ..... 2,825 sq. ft.
Heating surface, total ..... 3,011 sq. ft.
Grate area ..... 32 sq. ft.
Driving wheels, diameter ..... 69 ins. and 72 ins.
Material of driving wheel centers ..... Cast steel
Truck wheels, diameter ..... 30 ins.
Driving journals ..... 9 ins. by 12 ins.
Engine truck journals ..... 6½ ins. by 11 ins.
Main crank pin, size ..... 6¾ ins. diameter; 6 ins. long
Parallel rod pins, main ..... 7½ ins. diameter; 5¼ ins. long; others, 5½ ins. diameter by 4 ins. long
Cross-head pin ..... 4 ins. by 4 ins.
Cylinders ..... 15½ and 26 by 28 ins.
Piston rod diameter ..... 3¾ ins.
Main rod length, center to center ..... 131 ins.
Steam ports ..... length, 29¾ ins.; circular width, 1½ ins.
Exhaust ports ..... length, 29¾ ins.; circular width, 4½ ins.
Bridges ..... 3 ins. and 2¾ ins.
Valves ..... kind, balanced piston; travel, 5¾ ins.; outside lap, H. P. ¾ in.; L. P. ⅝ in.; inside lap, H. P. ⅛ in. negative; L. P. ¼ in. negative; lead H. P., 0 in.; L. P., ⅛ in.
Boiler, type ..... Wagon top
Working steam pressure ..... 200 lbs.
Material of boiler ..... steel; thickness, 11/16 in. and ¾ in.
Diameter of boiler ..... 66 ins.
Horizontal seams ..... Butt-jointed with double covering strips; circumference seams, double riveted
Thickness of tube sheet ..... ½ in.; crown sheet, ⅜ in.
Crown sheet stayed with ..... Radial stays
Dome, diameter ..... 31½ ins.

Tubes	Number, 350; material, iron, No. 11 wire gauge; diameter, 2 ins.; length, 15 ft. 6 ins.
Firebox material	steel; length, 118 3/16 ins.; width, 39⅛ ins.; depth, front 79½ ins.; back 67 ins.
Thickness of sheets, sides and back	5/16 in.
Fire brick arch, supported on	Water tubes
Water space	Front, 4 ins.; sides and back, 4 ins.
Grate, kind	Rocking bars and drop
Smoke box	Diameter, 67 ins.; length, 73 ins.
Exhaust nozzle	Single; diameter, 5 ins.
Smoke stack	Cast iron; 16 ins. diameter at choke
Tender, type	Eight-wheel
Tank	Length, 238½ ins.; width, 120 ins.; height, 58 ins.: collar, 10 ins.; fuel rack, 8 ins.
Tank capacity	6,000 gals.
Coal capacity	10 tons
Material of tank sheets	Steel; thickness, ¼ in. by 5/16 in.
Type of frame	Wood
Type of truck	Fox pressed steel
Type of truck springs	Elliptic and coil
Diameter of truck wheels	33 ins.
Truck journals	5 ins. by 9 ins.
Distance between journals	76 ins.
Diameter of axle in wheel	6⅝ ins.
Diameter of axle at center	5⅝ ins.

We must not expect impossibilities of the technical schools. Their work is particularly difficult, one reason being the impossibility of keeping the schools in touch with actual conditions of the practical work of life. Mr. Walter B. Snow, of Boston, recently read an interesting paper before the Society for the Promotion of Engineering Education which has been reprinted in a pamphlet. Its title is "The Relations of the Technical School and the Manufacturer." An engineer, who is also a successful manufacturer, is in position to offer valuable suggestions on such a subject. Mr. Snow emphasizes the importance of the commercial idea throughout the education, to overcome the tendency toward a preponderance of the "theoretical" side of the student's preparation. He treats the subject from the point of view of supply and demand, the schools being the producers of young engineers, and the manufacturers are the consumers. It is made clear that men who are in contact with commercial conditions are most needed, and in order to bring this fact before students an insight into the methods and spirit of the manufacturer by means of contact with living examples is urged by Mr. Snow. It is acknowledged to be difficult for instructors to keep in touch with practice. In this connection Mr. Snow suggests a broad use of the manufacturer's catalogue. He says: "The catalogue file is the elbow companion of every progressive teacher as it is of every working engineer, and its importance has already been emphasized by your discussions of the best methods of its arrangement. But it is only one of the means at the disposal of the teacher to keep himself and his pupils in close and intelligent relationship with the manufacturer." The combination of gumption and common sense with commercial features of education, and a close study of progress as indicated in the product of the leading manufacturers, seems to us to be the most important thought in Mr. Snow's address. That men of such experience are interesting themselves in technical education cannot fail to encourage educators who are endeavoring to keep pace with the progress of engineering.

The first number of the "Railroad Digest," the successor of the "Railroad Car Journal," fully justifies the predictions that it would be attractive, comprehensive and convenient. Its entire effect is pleasing and in good taste. It contains several excellent special articles by well-known authorities, but the principal feature is its digest of recent articles in the railroad papers of the world, and in this department the editors have condensed into a small space ideas which originally appeared in a large number of long articles. For this saving of time the busy reader is grateful, and we trust the publishers will realize even more than they hope for and expect.

CORRESPONDENCE.

A STUDY IN LOCOMOTIVE FIREBOXES.

To the Editor:

The article by Mr. Gaines on the stability of locomotive fireboxes in your December issue, suggests a direction in which important improvements can be made in locomotive boilers. Measurements of "radial-stay" boilers, when pressure is applied, indicate that many fireboxes do change their shapes, to the injury of the joints, staybolts and tube sheets. Below I describe a method of investigating the stability of the firebox section.

If Mr. Gaines, in his experiment with the cylindrical parchment paper, had placed a weight on top of the paper, he would have found that, under these altered conditions, his model would have assumed an elongated section instead of a circular one. Although, with an evenly distributed fluid pressure alone, the "curve of rest" is circular, conditions can alter it to some other curve. In the case of a boiler there is the evenly distributed steam pressure, and all the staybolts are pulling on the sheet with forces that are not equal and in directions which are not all radial. It follows, then, that other curves may be the "curves of rest."

This curve is obtained when the sectional area between the inner and outer firebox sheets is a maximum. To ascertain when this condition obtains we can consider the plates as straight between stays. Any two adjacent stays with the portions of the plates between them form a quadrilateral with fixed lengths of sides, and the area reaches a maximum when it can be inscribed in a circle. If all of these quadrilaterals can be inscribed in circles, it would seem that the "curve of rest" is obtained. It will be noted that the Belpaire boiler fulfils this condition.

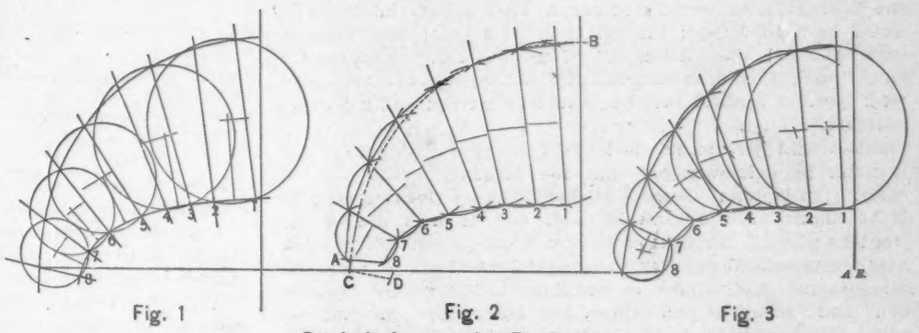


Fig. 1 Fig. 2 Fig. 3

Study in Locomotive Fireboxes.

Fig. 1 shows a "radial-stay" boiler, to which this test has been applied by drawing circles through three of the vertices of some of the quadrilaterals. It will be seen that these circles do not in any case pass through the fourth vertex. Fig. 2 was constructed by using the same lengths of stays as in Fig. 1, and the same spacing on the sheets. The shape of the sheets was altered, however, to make it possible to circumscribe a circle about each quadrilateral. The dotted curve AB shows the original sheet, as it was in Fig. 1. It will be noticed that the "curve of rest" is flattened somewhat from the circular arc, and it might be expected that measurements of the boiler shown in Fig. 1, when under pressure, would show that height had decreased and width increased. The staybolt CD has taken the position, 9, 8, indicating that a very great stress had been set up in the inner sheet, tending to break staybolts and destroy joints where the firebox widens. Fig. 3 was constructed by making the outer sheet the same as in Fig. 1, spacing the stays the same as in Fig. 1 in both sheets, but making the lengths of the stays and shape of the crown sheet come as they would by inscribing each quadrilateral in a circle.

G. F. Starbuck.

Waltham, Mass., December 29, 1900.

LOGICAL LOCOMOTIVE CLASSIFICATION.

To the Editor:

Lest there be some misunderstanding concerning the method of designating the types of locomotives as explained in the

issue for December, 1900, of the American Engineer, please allow me to suggest as follows:

Inasmuch as the maximum number of sets of wheels now used under locomotives and, as far as can be seen, the maximum that will be used for some time, is three, then there should be used three figures to designate each type. It is not important whether the figures indicate the number of wheels or the number of axles in the respective sets, except that, inasmuch as the present designation of types is, in some cases, on the basis of number of wheels, it would be well to have each figure indicate the number of wheels in a set.

There may be some question as to whether the first figure in the designation should indicate the number of wheels in the leading truck or in the trailing truck; a large number, probably a majority, of the railroads and locomotive builders show the right side of the locomotive in elevation drawings and in such cases the designation of type reading naturally from left to right would indicate the number of wheels in the elevation reading from right to left; it is suggested that there would be less confusion, however, if the first figure in the designation be used to indicate the number of wheels in the forward set and the last figure the number in the rear set.

Therefore, with the above explanation, it is suggested that whether a type has one, two or three sets of wheels, three figures be used in the designation of it, the first figure representing the number of wheels in the leading truck; the present 8-wheel type would become a 4-4-0 type; the 10-wheel would be a 4-6-0 type; the mogul, a 2-6-0 type; the "Prairie" type, a 2-6-2; the "Atlantic," "Northwestern," "Central-Atlantic" and tne "Chautauqua" would become one type, the 4-4-2 type. A 6-wheel switcher would be a 0-6-0; and a 4-wheel switcher, a 0-4-0.

This would give some fixed basis for type designation and it must be acknowledged that the present method has no basis; the layman refers to all heavy locomotives as moguls, if he knows such a term is used, and in such use of the word he gives it the usual meaning, great power. Even those who are presumed to know the distinctions of the present type designations apply different meanings to the names "mastodon" and "decapod" and others, and frequently confusion results. No confusion could result from the suggested method and, because it has a logical basis, its use by anyone presupposes the knowledge of the basis; therefore, errors in interpretation of it would be directly chargeable to the one making the error.

The present is a most favorable time to place on a satisfactory basis the designation of locomotive types and to this end a thorough discussion is desirable and that system which promises the best adopted at once. The method to be pursued in making a formal adoption of any new system is quite as important as to make a satisfactory choice of a basis of designation, and no method of adoption would be more certain and speedy than the immediate use of it, when decided upon, by the technical press; undoubtedly the stamp of approval by the Master Mechanics' Association, and possibly the railway clubs, would tend to make it official as well. The terms now creeping in are good enough as localisms, but they will not prove satisfactory for general use.

F. M. Whyte,
Mechanical Engineer.
N. Y. C. & H. R. R. R.

New York.

THE DESIGN OF CONNECTING ROD ENDS.

To the Editor:

With the usual design of connecting rod crank-end of the open or forked type, the closing block bolt is not only subjected to the shearing stresses due to the piston effort during its forward stroke, but it is also at times subjected to a further shearing stress of great intensity caused by excessive setting up of the key, which has occasionally resulted in the bolt being partly offset at the joint surfaces between the block and the rod, thus rendering it extremely difficult to remove the bolt, and completely ruining it for further use.

To obviate this difficulty, Mr. A. S. Vogt, mechanical engineer of the Pennsylvania Railroad, designed the connecting rod end shown in Fig. 1, and applied it to the Class E-1 express locomotives of that road, which were illustrated in the June issue of this journal, from which article the drawing is reproduced. It will be observed that instead of using a bolt through a block at the rear of the brass and a key in front of it, as is the usual practice, a U-shaped block is placed back of the brass with its flat portion bearing against the latter. The projecting ends of the rod take a semi-circular gib which is threaded for a nut on its lower end to hold it securely. The key passes between the U-shaped block and the gib, and a keeper held by the nut on the latter serves as a nut lock, and also holds a set screw for the key.

Fig. 2, reproduced from Vol. III of Maurice Demoulin's "Traite Pratique de la Machine Locomotive," illustrates the type of connecting rod crank-end used for the outside cylinders of a class of express compound locomotives belonging to the Prussian State Railways, and the feature of the design to which it is

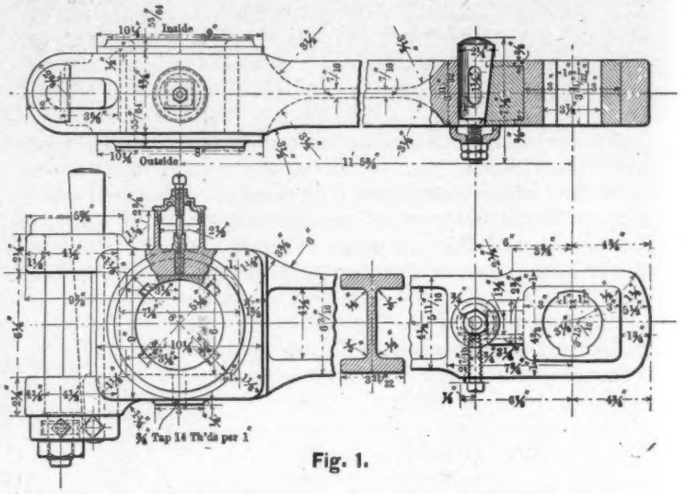


Fig. 1.

desired to direct attention is the method of fitting the closing block in the fork, which relieves the bolt of shearing stress.

A similar type of crank-end is employed by Signor Plancher for the inside rods of his 6-coupled, 4-cylinder compound express engine, which was exhibited by the Southern Railway of Italy at the Vincennes Annexe of the Paris Exposition. In this case, however, the closing block, instead of the rear brass, is tapered for the key, which, passing through the upper fork of the rod, is secured by a nut and lock nut bearing thereon. In all of the rods referred to, the keys at both ends of the rod are behind the brasses which they close, which arrangement reduces the change in length of the rod to a minimum.

Both the Pennsylvania and the Prussian State Railways de-

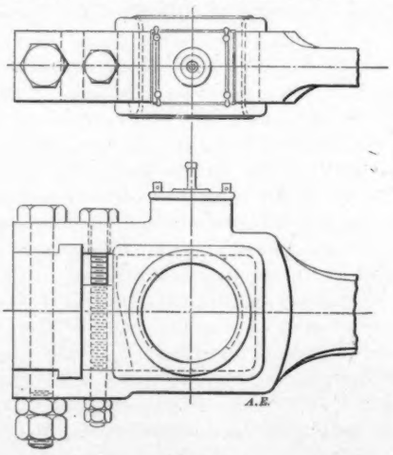


Fig. 2.

signs of rod end are excellent, but the latter does not appear suitable for engines having the parallel rods outside of the main rods, for, since the closing block must be removed from the fork laterally, this would probably necessitate taking down the side rods; which, in the event of failure on the road, would be an awkward procedure. Mr. Vogt's rod, however, is very easily disconnected from any type of locomotive.

When it is remembered that with 20-in. cylinders, piston rods 3¼ in. diameter, and 200 lbs. boiler pressure, the maximum shearing load on the closing block bolt is 61,173 lbs., or 30.58 tons (neglecting the very slight reductions for friction in the cylinder and the rod stuffing box), and that this normal load may

be greatly increased by water in the cylinder and by excessive key driving, the importance of relieving the closing block bolts of shearing stress, as in Fig. 2, or of eliminating them altogether, as in Mr. Vogt's design, will be readily appreciated.

New York. Edward L. Coster,
A. M. Am. Soc. M. E.

VOLUME OF LOAD ON BALLAST OR COAL CARS.

To the Editor:

It is often desirable to know what volume of coal, ballast or other similar material can be placed on a car of given size. It is an easy matter to find the capacity of the car level full and the volume of the heap may be computed by adding together the volumes of the two pyramids and that of the triangular prism between. But, as shown below, the whole volume can be as easily found at one operation.

In the diagram,

Let L = length of car,
W = width of car,
A = height of heap,
B = angle of heap,
V = volume of heap.

The part of the figure between the lines CD and EF is a tri-

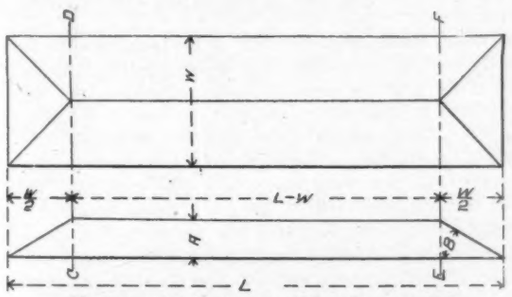


Diagram for Volume of Load on Cars.

angular prism of length (L — W) (since the angle of the slope is the same at the ends as at the sides) and the base equivalent to ½ AW and its volume is, therefore, ½ AW (L — W). The parts between the lines C-D and E-F, and the ends are equal pyramids with bases ½ W × W and height A and the volume of each is 1/6 AW², and of the two is 1/3 AW². Adding this to the volume of the prism we have V = ½ (L — W) + 1/3 AW² or ½ AW (L — 1/3 W). For A we may substitute its equivalent ½ W tan. B and the formula becomes V = ¼ W² tan. B (L — 1/3 W). If we take B = 30°, tan. B = .57735 and V = .14439 W² (L — 1/3 W). Stated in words we have the rule:

Multiply the length less one-third the width by .14439 times the square of the width.

J. H. Lonie.

N. & W. Ry., Roanoke, Va.

Mr. Charles K. Thomas has resigned as special representative of the "Railway Age," having been appointed General Sales Agent of the Reliance Machine & Tool Company, of Cleveland, manufacturers of the Morgan patent bolt cutter.

In a recent letter to the New York Herald, Mr. Charles H. Cramp, the well-known shipbuilder, commenting on the necessity of forced draft in marine practice, points out that "the maximum steam generating capacity of the Scotch boiler cannot be attained without forced draft equal to 2 ins. of water in the tube with closed fire room or ash-pit, or induced draft equivalent to it. The difference between natural draft and forced draft in a Scotch boiler is usually equal to 25 or 30 per cent. of the normal. Therefore, if it is contemplated to attain with natural draft a performance equal to that of forced draft with Scotch boilers, the weights must be increased in ratio of the difference. This would be out of the question in any type of warship now worth consideration. Indeed, the time is near at hand when the same rule will be recognized as applying with equal force to the higher classes of passenger vessels."

PERSONALS.

Mr. G. W. Guess has been appointed Purchasing Agent of the Waycross Air Line, with headquarters at Waycross, Ga.

General Manager George T. Jarvis, of the Wisconsin Central, has resigned and will return to the Louisville, Evansville & St. Louis.

Mr. T. H. Foque has been appointed Mechanical Superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, to succeed Mr. E. A. Williams, who has resigned to become Mechanical Superintendent of the Canadian Pacific Railway.

Mr. D. J. Durrell has been appointed Mechanical Engineer of the Pittsburg, Cincinnati, Chicago & St. Louis, with headquarters at Columbus, O.

Mr. H. B. Brown, Traveling Engineer of the Baltimore & Ohio, has been appointed Master Mechanic of the shops of that road at Chicago Junction.

Mr. F. H. McGee, Master Mechanic of the Seaboard Air Line at Americus, Ga., has been made Superintendent of Motive Power of the entire system.

Mr. Carl Hagan, General Foreman of the Wheeling & Lake Erie, has been made Master Car Builder of that system, with headquarters at Cleveland, O.

Mr. T. M. Price has been appointed Master Mechanic of the Findlay, Fort Wayne & Western, with headquarters at Findlay, O., in place of Mr. H. A. Hansgen, resigned.

Mr. Samuel Miller, Assistant Master Mechanic at the Indianapolis shops of the Pennsylvania since 1899, has become Master Mechanic of these shops, succeeding William Swanston, who has retired under the pension plan.

Mr. H. E. Poronto has been appointed Purchasing Agent of the Union Stock Yard & Transit Company of Chicago, and of the Chicago Junction Railway, with office in the Exchange Building, Union Stock Yards, Chicago.

Mr. G. L. Potter, General Superintendent of Motive Power of the Pennsylvania Lines West of Pittsburg, has been appointed General Manager, to succeed Mr. L. F. Loree, who was elected to the position of Fourth Vice-President.

Mr. F. C. Gates, Purchasing Agent of the Wheeling & Lake Erie, has resigned to engage in other business. His duties, as well as those of Superintendent of Telegraph, will be assumed by Mr. J. E. Shossig, Assistant to the General Manager.

Mr. A. G. Elvin has resigned his position as Master Mechanic of the Grand Trunk Railway shops at Montreal, Que., to accept the position of Assistant Superintendent of Motive Power of the Delaware, Lackawanna & Western at Scranton, Pa.

Mr. Louis C. Todd, Division Master Mechanic of the Boston & Maine, at Lyndonville, Vt., has been appointed Master Mechanic of the Fitchburg Division of the same road, with headquarters at Charlestown, Mass., to succeed Mr. J. S. Turner, resigned.

Mr. George Thompson, Superintendent of Motive Power of the Pennsylvania Division of the New York Central, has resigned and is to be succeeded by Mr. John Howard, Superintendent of Motive Power of the Hudson River Division of the Central-Hudson system. Mr. E. A. Walton succeeds Mr. Howard as Master Mechanic at New Durham, N. J.

Mr. S. Mahmoto, Director General, and Y. Kmosheta and F. Nozawa, Directors of the Imperial Government of Railways

of Japan, were on January 9 and 10 the guests of the Pennsylvania Railroad. The object of their visit was to inspect the Juniata shops and also those of the lines west of Pittsburgh. This they did in company with a party of railroad officials.

The many friends of Clement Hackney, formerly Superintendent of Machinery and Rolling Stock of the Union Pacific, will regret to learn of the news of his death, which occurred on January 6, at his home in Milwaukee, Wis., at the age of 54 years. He was born in Warrington, England, on May 16, 1846, and began his railroad career in 1860 as apprentice in the shops of the Prairie du Chien Railroad at Milwaukee, Wis. He was later with the Milwaukee Iron Company, first as Master of Transportation, then in charge of the Mechanical Department, and went to the Atchison, Topeka & Santa Fe in June, 1878, as Assistant Superintendent of Machinery, which position he held until December 1, 1885, when he became Superintendent of Machinery and Rolling Stock of the Union Pacific. He became General Manager of the Fox Pressed Steel Company in 1891, and after the absorption of that company by the Pressed Steel Car Company in 1899 was made District Manager of the latter company at Joliet, which position he held until August, 1, 1900.

Mr. T. R. Browne, Master Mechanic of the Pennsylvania Railroad at Juniata, has resigned to become Works Manager of the Westinghouse Air Brake Company at Wilmerding, Pa. Mr. Browne was appointed Master Mechanic of the Juniata shops at the age of 33, and for five years has had charge of the construction of the locomotives built by the road at that plant. Mr. Browne began as a machinist apprentice in Philadelphia, and after a varied experience, chiefly in civil engineering construction, and particularly in connection with hydraulic work, he entered the employ of the Pennsylvania ten years ago as draftsman at Altoona. He was soon made assistant to Mr. H. D. Gordon, Master Mechanic of the Juniata shops, during their construction, and succeeded Mr. Gordon in that position. His experience admirably fits him for his new position, and a better choice could hardly be made. He is of the sort of men the railroads need, and while his friends congratulate him and the Westinghouse people, it is not without regret that he will no longer devote his energies directly to motive power work, in which there is so much to be done just now.

At the January meeting of the North-West Railway Club, Mr. T. A. Foque, former Secretary of the club, was selected President, in place of Mr. E. A. Williams, resigned to go to the Canadian Pacific. Mr. T. W. Flannagan, Chief Clerk of the Mechanical Department of the "Soo Line," was elected Secretary to succeed Mr. Foque. The papers read at this meeting were "Electric Traction for Heavy Railway Service," by Mr. Edward P. Burch, Electric Railway Engineer, and "A Brief History of Composite Car Wheels," by Mr. Geo. H. Bryant, of Chicago. There was a good attendance.

If, as Mr. A. Lipschutz, of the Great Northern, says in a recent number of the "Railway Age," acetylene is sure to explode if heated to the dissociating temperature of 1,432 degs. F., it is a dangerous gas for railroad car lighting. It is understood that the Great Northern is using acetylene in a piping system and tanks which are soldered with soft solder or made of a metal which will melt at a temperature below that mentioned, so that the temperature of the gas will not rise above 400 degs. in case of fire. Instead of being reassured by this precaution, one is justified in being alarmed. This is placing a great deal of dependence upon those who mix the metals. It would seem to be better to use the present prevailing Pintsch system, or, if a brighter light is wanted, go to electricity at once.

PASSENGER COACH SANITATION.*

By J. N. Hurty, M.D., Indianapolis, Ind., Secretary State Board of Health.

Professor John Fiske, in a recent esssay, remarks: "Americans pride themselves on being extremely practical, yet we have not learned how to ventilate a Pullman car." In view of the havoc wrought by pulmonary tuberculosis, pneumonia and other diseases of the air passages, all largely due to lack of ventilation, this remark is calculated to lessen our conceit and cut our pride of invention to the quick.

The first step in passenger coach sanitation is sanitary construction. Angles, carvings, panels, bead work, channeling, all aid uncleanliness. These further the collection of dirt and make cleaning difficult and expensive. Transom ventilation in the deck fitfully and insufficiently changes the air, and is altogether a method which is contrary to physics. Such method does not and cannot ventilate a car properly, and sometimes, as when cold air falls upon the heads and necks of passengers through the transoms, is almost worse than no ventilation. Dr. Dudley, of the Pennsylvania Company, has devised a method of introducing pure air into coaches which probably meets all conditions so far as is practicable, but the removal of the air through transoms in the deck is wrong. Dr. Dudley describes his invention now in use on the Pennsylvania system as follows:

"We have experimented with and developed a system of ventilation which promises very good results, and is a great improvement over former methods. This system consists in taking air in at diagonally opposite corners of the car, through a hood, and by means of a down-take underneath the floor of the car, to the space bounded by the outside sill, the first intermediate sill, the floor and the false bottom. This space extends the whole length of the car. From this space the air passes up through the floor into the heater boxes, the apertures in the floor being 12 ins. long by 2 ins. wide, and being located between all seats on both sides of the car. In the heater boxes the air is warmed, and from these boxes under each seat the air passes out into the car, and finally to the outside through the ventilators in the deck of the car."

The boxing of the heating pipes, as here described, is attended with material disadvantages. First, needed space, when two persons are in on seat, is taken up; second, offensive and unremovable accumulations of dirt occur within the box. While this boxing presents advantages it does not seem essential and I would do away with it.

The Dudley, or Pennsylvania method, furnishes sufficient air from the outside and warms it immediately that it enters the car. My modification would be the abolition of the boxing over the pipes, and removal of the foul air from near the floor through ducts placed within the closets and the washrooms at both ends. These ducts would be made of galvanized iron, as wide as the closet, say 36 ins., and have a depth of 8 ins. and lead upward through the roof, terminating in a hood, the ends of which are covered with stout wire netting, and within which is a light and easily swinging, deflecting leaf or plate which readily responds to wind action. This leaf will tilt in accord with the direction of the movement of the car, and thus the air forced through the hood when the car is in motion will act the same as a steam injector and aid greatly in lifting the air column. The lower end of the ventilating shaft would be raised about 8 ins. from the floor to permit the entrance of the foul air at the floor level. In order to give the duct constant draft, a branch of the heating pipes should be placed therein. This would heat the interior, cause the air column to rise, and thus create an upward draft. In addition to this, and for reserve, a Pintsch gas jet could be supplied to the interior of each duct, and this, when lighted, would serve to heat the air column and cause it to rise. Four such ventilating ducts, two at each end of the car, would have a combined cross section area of 8 sq. ft., and if the air moved upward through them at the rate of 2 cu. ft per square foot per second—a slow rate—they will remove each minute 960 cu. ft., thus effecting a complete change of air throughout the whole car, about every six minutes, supplying each passenger—60 to the car—with about 15 cu. ft. per minute. Either standing still or moving a car equipped as described would be well ventilated.

*From a paper read before the International Association of Railway Surgeons. Reprinted by "The Railway Surgeon."

Cleanliness.

Window frames and sills should be rounding, the car sides perfectly smooth, the seat frames should be perfectly plain, the seat arms never upholstered, but on the contrary made of hard polished wood or enameled iron, and round, simple and plain. The seat supports next the aisle should be simple, round, enameled iron posts. Curved, fluted and elaborate supports should not be thought of, and it would be well to do away with foot-rests, for they are not really necessary, favor dirt accumulation, and are a hindrance to cleaning. The floors should be hardwood, well filled, and kept so.

Apparently, plush must be continued and frequent renovation be depended upon to keep it as sanitary as possible. In order to accomplish this, seat frames should be skeleton and so constructed as to admit of the easy removal of the plush upholstered bottoms and backs. At present, I know of no car seat from which the backs can be readily removed. Slats or blinds should never be used at the windows. Only smooth, impervious material on automatic rollers should be tolerated. The plain, uncarved interior need not be without ornament, for painted panels, stenciling and frescoing would take their place to relieve the eye.

The strip of carpet or matting now frequently seen in car aisles should never exist. It would be allowable to have a rubber strip, which is impervious and susceptible of thorough cleaning. Hardwood, polished floors with rugs, as we have in our modern homes, would not be practicable because it would be impossible to walk about the moving car owing to slipping. To obviate this, rubber tile flooring could be laid. This would be ornamental, free from slippery smoothness, impervious and in every way practicable and excellent. On it rugs could be spread, and the easy removal of the rugs for cleaning would greatly improve sanitation.

The only way to secure fit drinking water is to sterilize, distil or filter it. It could be dispensed from water tanks, as at present, and the drinking cup should be glass; tin or metal cups should be carefully avoided. The Pennsylvania road uses glass tumblers with rounded bottoms; these are, however, always fluted. I would recommend they be perfectly smooth. Of course, careful persons carry their own drinking cups. It would be practicable for railroads to furnish small paper cups in a penny slot machine, attached to the side of water reservoirs.

The present passenger coach water-closet is a nuisance, pure and simple. Before the car has gone fifty miles it is offensive. The closet must exist, but how may its nuisance character be abolished? Of course, no matter what its construction, the closet, unless properly cared for, will be offsensive, yet much remains to be done on account of better sanitary construction. It is imperative that floor and side walls of closets shall be of impervious material, and side walls perfectly plain and smooth. The porcelain hopper should be bell-shaped with the larger diameter at the bottom and the smaller diameter at the top. Such shaped hoppers would not likely become soiled and foul. Instead of receiving excreta upon the trucks, which is frequent in present construction, it should be received in removable drawers or boxes of iron, containing dry earth; and an arrangement provided whereby dry earth could be easily supplied in right quantity whenever the closet was used. If all arrangements are proper there would be no attending offense. At terminals the drawers could be removed, emptied, cleaned, and returned to place.

Cleaning and Disinfecting.

Being sanitarily constructed as described, a coach on arrival at a cleaning station should have the bottoms and backs of seats taken out and immediately placed in a steam sterilizer of sufficient capacity where they would be thoroughly sterilized and afterward dusted by means of the air blast. Or, ordinarily, they might be dusted first and then sterilized. If the seats and backs were kept in duplicate, clean sterilized seats could always be at hand. As soon as this first cleaning step has been taken, the floor of the car should be lightly sprinkled with water containing a very small amount of some efficient disinfectant (formaldehyde preferred) and then swept. Scrubbing with soap and water should then follow, the arms of the seats and all surfaces which need it should be washed and wiped and all dust taken up with damp cloths.

For car disinfection Mr. W. Garstang, Superintendent of Motive Power of the "Big Four," has invented a giant spray. This is a strong copper can with a capacity of one gallon, provided with an atomizing tube of proper size. It is attached to the air hose, and after filling with formaldehyde the workman enters the car and proceeds to the opposite end, dragging the hose after him. He now quickly backs out, spraying the chemical onto the floor, side walls, window sills, into corners, and onto bottoms and backs of seats. The air pressure is so strong and the atomizing tube so well adjusted, that the formaldehyde is driven forth more as a nebula than a spray. By means of this nebulizing the formaldehyde gas is set free and penetrates every part of the car, effecting complete disinfection. A car thus treated does not manifest animal odors upon standing closed in the hot sun.

Sleeping Cars.

In sleepers, the men's wash and smoking room, with its carpet, its plush upholstered seats and hangings, is a veritable filth hole at the end of a trip. Let the impervious rubber tile floor of the wash room be without even a rug. Let also the rubber tile floor cover the entire car, and, if desired, use rugs between seats. The heavy curtain which hangs at the wash room entrance is all too frequently pushed aside by polluted hands. Who can doubt what result would be obtained if a bacteriological examination of such a curtain was made? A plain hardwood, highly polished door should take the place of these curtains.

The compartment sleeper solves the problem of the abolition of the berth curtain, which, as a filth collector, has few equals and no superiors. Traveling in Colorado, I once saw a consumptive wipe out his mouth with the berth curtain, after a severe attack of coughing, followed with expectoration. What magnificent collectors and distributors of pneumonia, diphtheria and like infections car curtains must be! Repeated inquiries have failed to elicit information concerning the steaming of the blankets used on sleepers. I contend these blankets should be white, and then the story of cleanliness would be quite satisfactorily told. I have learned that these blankets are frequently aired. This is well, but it is not sufficient, especially as they are aired in railroad yards where conditions are surely not good. Anything less than steam sterilization after every using cannot be acceptable. It goes without saying that the mattresses should be frequently submitted to steam sterilization.

Dining Cars.

Many surprises are in store for those who have not made sanitary inspection of dining cars. In diners carpets should never be found. The rubber tile floor should be used and extreme plainness of interior exist. The food boxes, when of wood and unlined with impervious material, are an abomination; they cannot be kept sweet. Zinc lining is not acceptable for the zinc wears away, and between it and the wood accumulations which occur, bring forth odors to taint the food and possibly to furnish unwholesome products of decomposition. Wooden slat shelves in dining car food boxes are extremely unsanitary. I have taken such wooden shelves out which exhaled sickening odors and which could not be rendered free from smell after soaking in strong formaldehyde. Cleaning and scalding seemed not to lessen the bad odor of these wooden shelves. The discoveries of Vaughn in regard to the formation of poisons in foods warn us not to trifle with wood or other absorbent material in refrigerators. The dining car food box should be made of steel boiler plate and porcelain lined; the slatted shelves should be of metal porcelain covered. Such a food box could be easily cleaned with a jet of steam or by scalding with boiling water. I would emphasize this matter concerning food boxes, for my experience in inspecting them has been disgusting.

The United States Hotel, Saratoga, N. Y., will open June 15 for the benefit of those attending the Master Mechanics' and Master Car Builders' conventions. Those who selected this hotel last year will do so again and probably also a large number in addition, especially those who appreciate the dignified, quiet comfort which Messrs. Gage and Perry so well provide. Everything will be done for the comfort and convenience of their guests and entire relief from the crowd and the exasperating delays at the table with other uncomfortable convention experiences may be had by going to this hotel.

GRAPHICAL METHOD OF OBTAINING THE SPEED OF LOCOMOTIVES.

The accompanying diagram is for use in determining the speed of a locomotive approximately, in miles per hour, by counting the revolutions of the driving wheels. This engraving, which was prepared from a drawing received through the courtesy of Mr. E. B. Thompson, Mechanical Engineer of the Chicago & Northwestern Railway, will be found convenient in indicating engines, as it is often desirable to take the cards at a certain rate of speed.

The figures along the base line of the diagram indicate the diameter of driving wheels in inches, and the figures on the

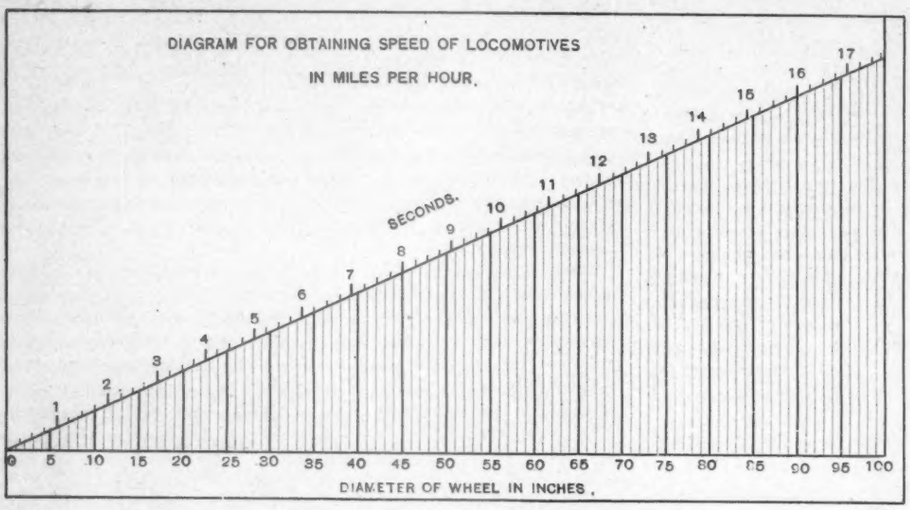


Diagram of Speed of Locomotives.

oblique line indicate seconds. To find the speed of a locomotive with 80-in. drivers, follow the base line marked "diameter of wheels in inches," until striking the ordinate marked 80. This ordinate touches the oblique line very near the point marked 14¼ seconds. By counting the number of revolutions of the driving wheel for 14¼ seconds, the result will be the speed in miles per hour that the engine is running. This method is sufficiently accurate for ordinary purposes. It is based upon the old idea of taking the speed of a train by counting the number of 30-ft. rails passed over in a space of 20 seconds.

A new process for rolling rails has been put into operation at the Edgar Thompson Steel Works, with the object of improving the quality of large rails. The process has been developed by Julian Kennedy and Thomas Morrison, and is known as the Kennedy-Morrison process. Its object is to provide for finishing the heads of rails at a lower heat without reducing the temperature at which the blooms are rolled, which is not too high for the earlier passes. It is also desirable not to decrease to too great an extent the temperature of the web and flange. The process provides an interval of time between the intermediate and finishing rolls which is just sufficient to bring each rail to the temperature which has been found to give the best results. The rail is laid on the cooling bed on its side with the head close up to the flange (or bottom) of the rail in front of it, so that the metal in the combination of two rails is about equally distributed, which allows the rails to cool gradually without causing them to become distorted. A great deal of the heat which leaves the head of the rail is absorbed in the flange of the rail adjoining it, thus keeping the temperature of the flange from being unduly lowered while the head is cooling. This is done without interfering with the rapidity or continuity of action of the mill, and it results in improving greatly the quality of the product. The process requires a special arrangement of machinery to provide this pause in the rolling. This and the machinery for operating the intermediate cooling table are fully described in "The Iron Age" of December 20, 1900.

In English locomotive practice, according to Mr. Charles Rous-Marten, in "Locomotive Engineering," the year just closed has developed a disposition toward "earnest consideration" of the compound. It has also brought about an increase of boiler power of 40 per cent., and in steam pressure, 12 per cent.

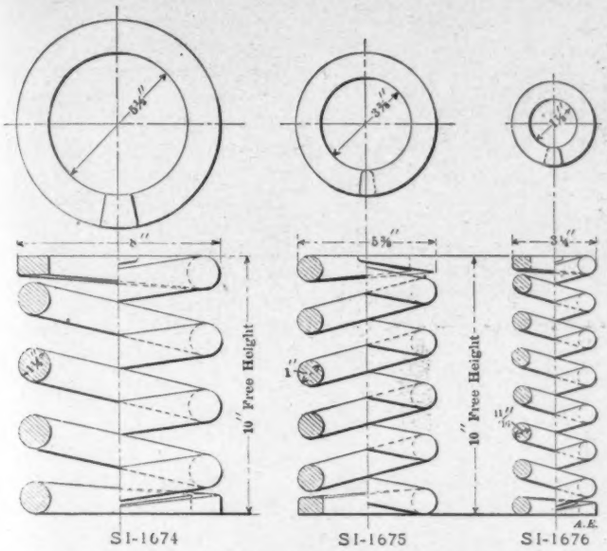
To settle the comparative efficiency of centrifugal fan blowers versus steam-jet blowers for the production of boiler draft, Mr. B. R. Healey recently made some experiments upon a standard type of refuse-burning furnace having 25 sq. ft. of grate surface. He states in a recent paper read before the Society of Engineers, London, that in each case "the furnace was got to full heat before commencing to record the results, and every care was taken to ensure precisely similar conditions for each test. The steam pipes were well covered with hair felt, the steam pressure was kept at 80 lbs. during each trial, and the blast mains and blower outlets were all 9 ins. in diameter. The first experiment was with a Korting steam-jet blower, the initial nozzle being 25-in. diameter, which gave a pressure of .20-in. water gauge. The second experiment was with a small high-speed engine geared direct to a Sturtevant centrifugal blower, and by using exactly the same weight of steam the pressure was increased to .60 in. In these two experiments the furnace gases passed through a multitubular boiler 10 ft. long and 6 ft. diameter to a stack which was 40 ft. high above the grate. Two other experiments were afterward made without the boiler, and the furnace gases passed direct to a special chimney 12 ft. high over the furnace, and it was found that with the same blast pressure the incinerating power of the furnace was as nearly as possible the same as before, which indicated the extra duty the stack has to perform when steam generators are used. A fifth experiment was made with four Korting steam-jet blowers of the same size as the one used in the first experiment. These were fixed to a sole-plate at the top of the chimney 12 ft. above the furnace and used as exhausters. The ashpit doors being open, it was found that the in-draught at the furnace doors was only .25-in. water gauge. The power of the furnace was considerably less than in the other experiments, although using four times the quantity of steam. The result was anticipated, but the experiment was made to convince certain parties of the folly of using steam-jets to any large extent in chimneys."

Less than one pound of coal per indicated horse-power per hour—to be exact, 0.97 lb.—is recorded by "Engineering," of London, for the new steamships, "Inchdune" and "Inchmarlo," on voyages between Hartlepool and Dover. These ships have Mudd's five-crank engines and a boiler pressure of 267 lbs. generated in two single-ended boilers, with Ellis and Eaves' system of induced draft. Fitted in the uptake, immediately above the level of the highest row of tubes, is the Central superheater, a device designed and patented by the Central Marine Engine Works. It consists of a series of wavy tubes through which the steam is made to pass on its way from the boiler to the engine. The steam from the boiler enters at the top, where the gases are comparatively cool, and passes out of the main steam pipe at the lower end, where the gases are hottest. A temperature of 460 degrees to 480 degrees Fahrenheit is easily obtained. Above the superheater come the air-heating tubes and casings, which, together with the fans, constitute the induced-draught system. The engines have five cylinders, of diameters respectively of 17 ins., 24 ins., 34 ins., 42 ins., and 42 ins. by 42 ins. stroke, the high-pressure valve being of the piston type, and the others flat valves.

STANDARD EQUALIZER SPRINGS.

For Passenger Equipment, Lehigh Valley Railroad.

Our attention has been called by Mr. F. F. Gaines, Mechanical Engineer, Lehigh Valley Railroad, to a very convenient



Standard Equalizer Springs, Passenger Equipment, Lehigh Valley Railway.

and compact tabulated form, used in ordering equalizer springs for passenger equipment. Over thirty different springs were formerly in use on that road for this particular equipment, but by different arrangements of the three springs shown in the engraving this number can be reduced to three. These springs are made 10 ins. in free height and of 1¼, 1 and 11/16-in. wire, with outside diameters 8, 5⅜ and 3¼ ins., respectively. The accompanying tables show the different combinations of these springs for 6 and 4-wheel trucks, with the minimum and maximum car weights for each combination. In ordinary equalizer springs all can be shown in one drawing together with the tables of specifications and weights for the four combinations. This same arrangement is now being worked out for bolster springs.

Spring No. 1674.

Cars having 6-wheel trucks. Min. Car Weight.	Cars having 6-wheel trucks. Max. Car Weight.	Cars having 4-wheel trucks. Min. Car Weight.	Cars having 4-wheel trucks. Max. Car Weight.
48,600	63,800	42,500	57,790

Springs Nos. 1674 and 1676.

Cars having 6-wheel trucks. Min. Car Weight.	Cars having 6-wheel trucks. Max. Car Weight.	Cars having 4-wheel trucks. Min. Car Weight.	Cars having 4-wheel trucks. Max. Car Weight.
64,600	79,800	58,500	73,700

Springs Nos. 1674 and 1675.

Cars having 6-wheel trucks. Min. Car Weight.	Cars having 6-wheel trucks. Max. Car Weight.	Cars having 4-wheel trucks. Min. Car Weight.	Cars having 4-wheel trucks. Max. Car Weight.
80,600	95,800	74,500	89,700

Springs Nos. 1674, 1675 and 1676.

Cars having 6-wheel trucks. Min. Car Weight.	Cars having 6-wheel trucks. Max. Car Weight.	Cars having 4-wheel trucks. Min. Car Weight.	Cars having 4-wheel trucks. Max. Car Weight.
96,600	112,600	90,500	106,500

Specifications.

	SI-1674	SI-1675	SI-1676
Shape number			
Outside diameter	8 in.	5⅜ in.	3¼ in.
Diameter of wire	1¼ in.	1 in.	11/16 in.
Free height	10 in.	10 in.	10 in.
Solid height	6¼ in.	6¼ in	6¼ in.
Load at solid height, pounds			
Load at 8½ inches, pounds			

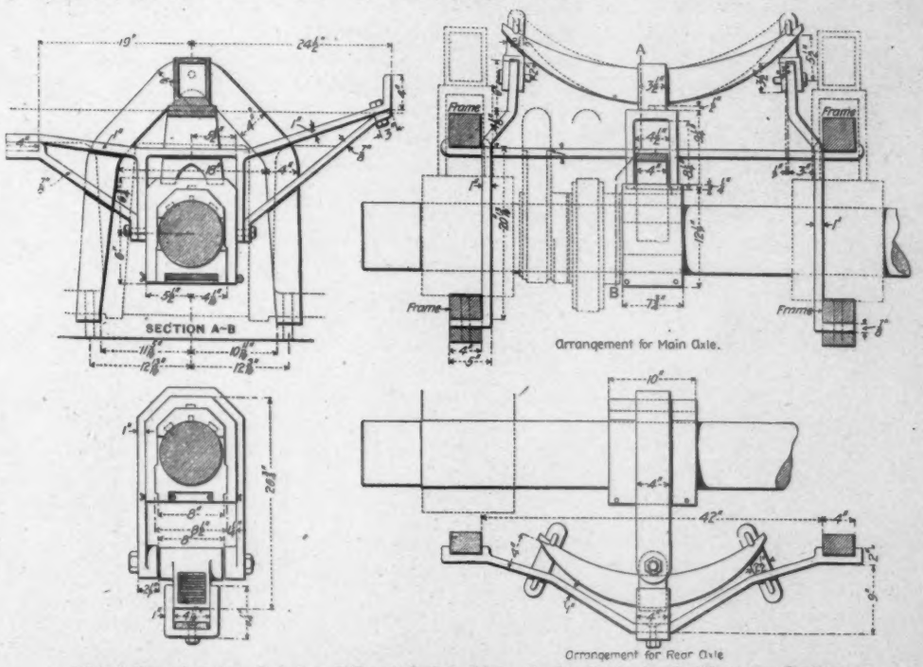
All heights to be within ⅛ in. of those specified. To be free from permanent set.

MIDDLE BEARINGS ON DRIVING AXLES.

New York, Ontario & Western Railway.

In order to overcome a serious difficulty with hot driving boxes of some mogul freight locomotives built in 1893, having 19 by 24-in. cylinders, 63-in. driving wheels and a total weight of 138,000 lbs., Mr. West, Superintendent of Motive Power of the New York, Ontario & Western, devised a third bearing for the driving axles of one of the engines to relieve the other bearings of a portion of their loads. These journals were but 8 ins. in diameter and the relief thus afforded about a year ago was so satisfactory as to lead to the application of the same plan to all the engines of that class. It has also been applied to the rear driving axle of engines of the 8-wheel type with equally good results. Mr. West states that he is now applying these bearings to new and heavier mogul engines for milk train and heavy passenger service now being built at the Cooke Locomotive Works. The device is the subject of a patent application.

The construction is clearly shown in the engraving. For the main axle a pair of pedestals are made in a short supplemental frame supported between a transverse frame brace and one of the plate boiler braces. The load is applied through stirrups under the main frames and a transverse leaf spring bearing on a step over the middle bearing. The lower view illustrates the method used on the rear axle, in which case there is not sufficient room for the pedestals and frame over the box. The bearing at the center of the main axle is 7¾ ins. long, which is all that could be obtained between the eccentrics, while on the rear axle a length of 10 ins. was used.



Third Bearing for Driving Wheel Axles—New York, Ontario & Western Railway.

A record of 1,217 locomotives built in the year 1900 was made by the Baldwin Locomotive Works. Of these, 426 were Vauclain compounds, 363 were exported, 48 were electric, and 6 were built for compressed-air power. The aggregate weight of the locomotives was 19,277,900 lbs., or 96,388 tons, and when spare parts are included the total weight was more than 100,000 tons. If the length of each locomotive and tender is assumed to be 60 ft., the 1,217 locomotives would make a train over 13 miles long. The average weight of each engine and tender empty was 158,500 lbs., while for the year 1890 it was but 106,000 lbs. an increase of about 50 per cent.

Machinery and Transportation Building.

PAN-AMERICAN EXPOSITION.

To Open at Buffalo, New York, May 1, 1901.

This exposition, which is to celebrate the achievements of civilization in the Western Hemisphere during the past 100 years, by a display of the arts, industries, manufactures and products of the soil, mine and sea, will be opened May 1, 1901, and continue for six months. The site chosen for this purpose is in the northern part of the city of Buffalo, in the vicinity of Niagara Falls, and within a day's journey from the homes of 40,000,000 people. Of the 350 acres comprising the exposition grounds, 133 acres are picturesque park and lake lands. The architecture of the 20 or more large buildings is a liberal treatment of the Spanish Renaissance. These buildings surround 33 acres of open courts, with more than 125 original sculptured groups, and court settings of unexampled beauty.

Entering the exposition grounds by the main entrance on Lincoln Parkway, the first buildings that come to view are the Albright Gallery of Art on the left, which is designated by No. 1 in the accompanying plan of the grounds, and the park shelter and boat house, E-2, on the right. Continuing north along the park drive, the first glimpse of the New York State Building, No. 9, is caught as entrance is made to the spacious courts, which are, as shown in the engraving, to be in the form of an inverted T. Besides the structures that immediately surround these courts are buildings of a miscellaneous order. At the extreme end of the main court, and to the east side, is situated the Stadium, marked O in the engraving, which has a seating capacity for 10,000 people. The arena will have a quarter-mile track and ample space for athletic contests of all kinds. On the opposite side of the court is the Midway, comprising nearly 30 acres, to be devoted to novel entertainments, the cost of which is estimated at $2,500,000. The state and foreign buildings are located at the right of the main entrance to the courts and occupy 15 acres. There are also music halls, cafes, band stands, live stock farms and other structures not shown in the engraving.

Of the many large buildings of great interest, the two appealing more closely to our readers are the machinery and transportation building and the electrical building. These two buildings, Nos. 12 and 13, are located one on each side of the Court of Fountains.

The electrical building is 500 x 150 ft. and the 75,000 sq. ft. of exhibition space available in this building will be divided into three divisions, namely, the service plant for the transformation and distribution of 5,000 horse-power, transmitted from Niagara Falls for lighting and power purposes; a collective exhibit of historic interest, and the commercial exhibit, showing articles possessing distinctive merit. These divisions have been subdivided into 14 groups.

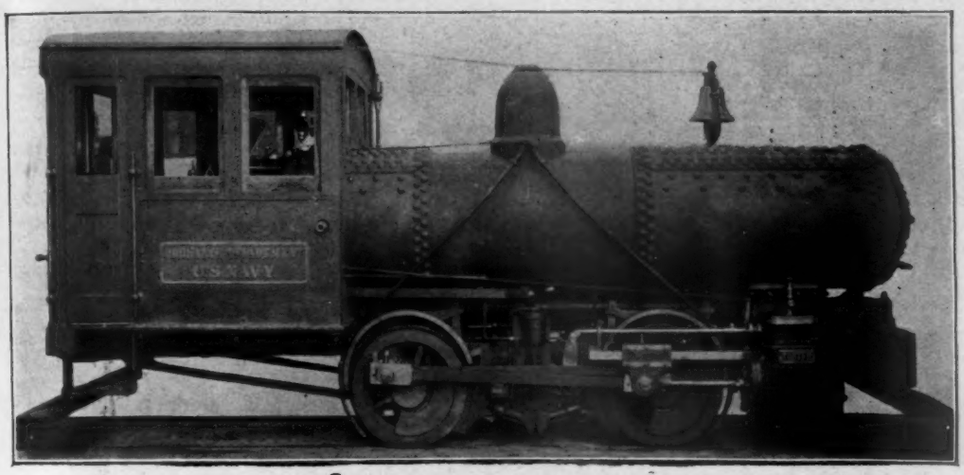
One of the largest structures of the exposition is the machinery and transportation building, which is shown in the accompanying half-tone engraving. Its dimensions are 500 x 350 ft., and the architectural work of the building is a masterpiece in the style of the Spanish Renaissance. The exhibits in the machinery division will be made representative in each particular line, rather than exhaustive, and the aim will be to present exhibits possessing distinctive novelty and educational value. In the transportation exhibits some of the important features will be the automobiles and horseless carriages of every description. The rapid developments that have taken place in trolley cars will be shown, and a fine up-to-date exhibit of railway cars and trains and interesting steam and electric locomotives will be included. Marine exhibits will show the development in lake, river and ocean navigation up to the present time. In the graphical arts, the largest exhibits

Plan of Exposition Grounds

will be those of newspaper presses, particularly the newest rotary and duplex machines. The ordnance displays will also be made in connection with the transportation exhibits as well as agricultural machinery and implements.

The most prominent feature of the exposition will undoubtedly be the brilliant electrical effects, because of the nearness

to Niagara Falls, where the greatest power plants in the world have been installed. Over 200,000 incandescent lamps will be used in lighting the courts, and it is the purpose to make this the most brilliant, fantastic and beautiful electric-lighting effect ever attempted. Much has been said about the exposition, and investigation indicates that it will not be a disappointment in any particular.

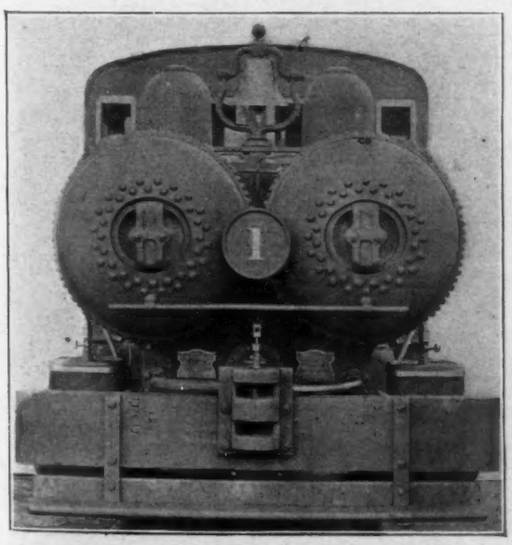


Compressed Air Locomotive—Ordnance Department, United States Navy. Built by H. K. Porter Company, Pittsburg, Pa.

COMPRESSED AIR LOCOMOTIVE.

H. K. Porter Company.

The large compressed air locomotive illustrated in the accompanying engravings was built recently by the H. K. Porter Company and delivered, together with a complete plant for charging and operating the engine, to the Ordnance Department of the United States Navy, at Iona Island, New York, for service at the large magazines for explosives at that place. It will replace part of the old mule service on the island for



Front View of Compressed Air Locomotive.

pulling railroad cars about the ammunition storehouses. This type of locomotive was decided upon by reason of the absolute necessity of avoiding fire of any kind near the magazines.

The weight of the engine in working order is about 40,000 lbs. It is of the double tank design with four driving wheels to run on standard gauge tracks. The drivers are 30 ins. in diameter and have a rigid wheelbase of 6 ft. The cylinders are 12 ins. in diameter with a 16-in. stroke. From the highest point of the locomotive down to the rail is 10 ft., the widest part about 9 ft., and the length over the bumpers is 20 ft. It has two air tanks, each 40 ins. outside diameter, with a combined capacity of 240 cu. ft., and these are designed for a working pressure of 750 lbs. Below these two large tanks and midway between the cylinders is a third tank 10 ins. in diameter and 12 ft. in length. This auxiliary tank has a capacity of 6½ cu. ft. and is fitted with a reducing valve by which the air is reduced automatically from the pressure in the main tank to 140 lbs. per square inch, the regular working pressure, in the cylinders. The engine is fitted with an air whistle, bell, track sander, inside-hung air brakes, applying to all four drivers, and is one of the largest compressed air locomotives ever built.

The plant at Iona Island consists of one locomotive, a series of charging stations along the tracks for charging the locomotive when necessary, and a complete power plant for operating the compressors. The time required in charging the locomotive is less than 30 seconds. On the success of this engine hinges an order for a number like it, to be used in the same service on the island.

Hon. Charles A. Prouty, of Washington, D. C., member of the Interstate Commerce Commission, delivered on January 21st an address before the engineering students of Purdue University. His subject was "The Railroads and the People."

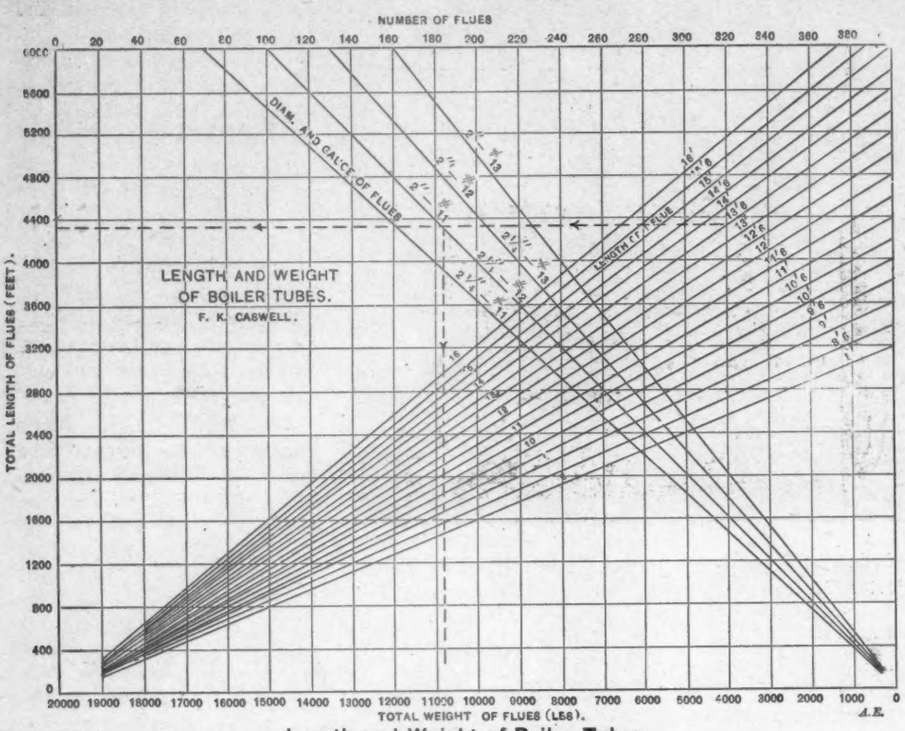
The "Railway Master Mechanic" appears in new size and form in its January number. It has been changed to the standard of 9 by 12 ins. and is attractive in every way. Mr. W. D. Crosman continues as Editor, and Mr. Allen R. Cosgrove is Manager. Last month we stated that Mr. Bruce V. Crandall had purchased this publication and also the "Monthly Official Railway List." This was an error, for he has purchased the "Railway Master Mechanic" only and will conduct it as publisher. The first number under the new ownership promises increased success and improvement in every particular.

The usual causes for hot driving boxes must necessarily be understood where 75 engines are operated on a division for two months without a single delay from hot driving boxes, and yet making an average mileage of 4,157 per engine per month. Mr. M. E. Wells records this in a brief paper before the Western Railway Club. He considers constant systematic care more important than any other half-dozen remedies. It is not more oil but more care to keep the packing in good condition; not what men are instructed to do, but what they actually do, that is so important. In ten-wheel engines Mr. Wells finds it necessary to examine the front driving boxes every 510 miles, the main boxes every 1,020 and the rear ones every 1,530 miles because of that ratio in the liability of heating. The packing is thereby kept always in good condition. Mr. Wells believes the following to be factors of importance: Side oil holes, not lower than 2½ ins. above the center line of the journal; moderate pressures (5 or 6 tons) for placing bearings in driving boxes; tight-fitting oil cellars, to prevent the boxes from squeezing in at the bottom and a disposition of the cellar packing which will prevent particles of waste from being carried over the journals.

LENGTH AND WEIGHT OF BOILER TUBES.

By F. K. Caswell.

In designing locomotives, where the weights have to be held strictly within given limits, the item of weight of boiler flues becomes an important one. Oftentimes, the change of one gauge in the thickness of the flues will enable the designer to keep the weight within a given limit and yet retain the desired total heating surface.



Length and Weight of Boiler Tubes.

Where weight of flues is to be figured separately for each case, considerable time is involved. To avoid this delay, and also to provide a ready means for finding the difference in weight between flues of different lengths, the accompanying chart was prepared, and is used as follows:

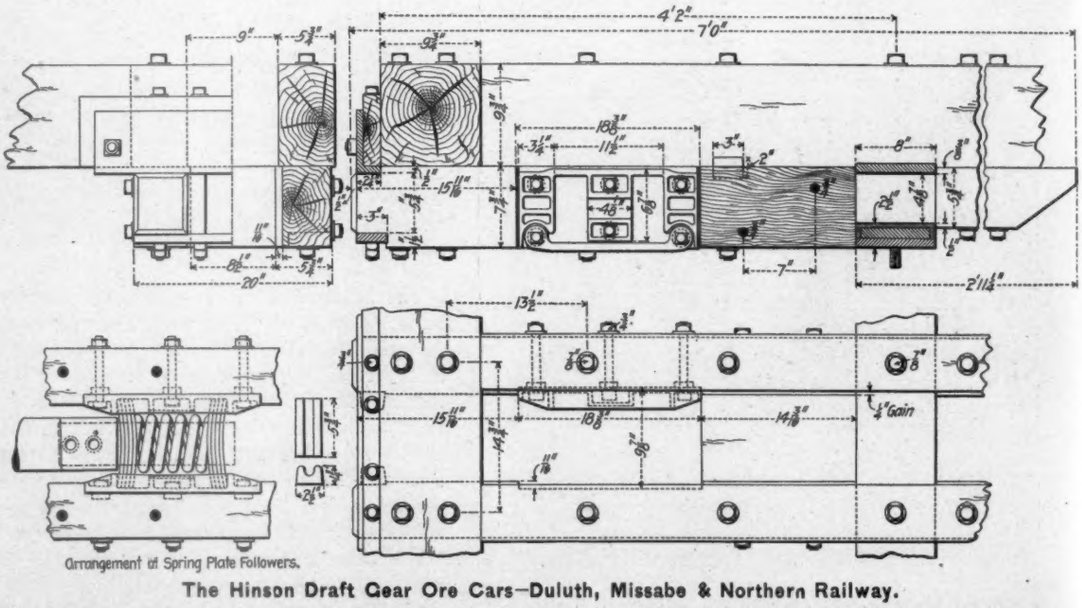
Starting at the top of the diagram with the given number of flues, follow the line vertically until it intersects the diagonal of the given length of flues. (For figuring weights or aggregate lengths, this length should be taken as 1 in. over the nominal lengths to allow for beading.)

Follow the horizontal line at this intersection to the left until it intersects the diagonal of the given diameter and gauge (B. W. G.), and thence to the bottom of the chart, where the total weight can be read from the scale. In making estimates it is often necessary to know the aggregate length of the flues. This figure can be obtained from the scale at the left, as indicated by the dotted lines, which for 320 2-in. flues 13 ft. 6 ins. long, No. 11 B. W. G., give 4,340 ft. and 10,800 lbs. respectively.

THE HINSON DRAFT GEAR.

The accompanying engraving illustrates the application of the Hinson draft attachment to ore cars on the Duluth, Missabe & Northern Railway, where it has given good results in severe service for several years. The essentials are cheek castings of malleable iron or cast steel, with removable under-straps, the usual coil springs and crucible steel spring follower plates in place of the usual rigid followers. These spring follower plates have a capacity of 80,000 lbs. applied by means of the coupler and they act like the usual rigid followers, except when subjected to very heavy pulls or jerks. Such jerks are graduated by the combined elasticity of the coil and follower springs, relieving to the extent of their capacity the draft rigging and car framing from the destructive shocks which are imposed through rigid followers. In the design illustrated the follower springs are 8½ by 5⅞ by 5/16-in. plates, with an initial number of ⅜-in., four of these being used in each follower. Mr. Wm. Smith, Superintendent of Motive Power and Cars of the Duluth, Missabe & Northern, writes of this draft gear as follows:

"We have had it in use about three years and have 900 cars equipped with it. During this period we have only broken six of the levers in our entire equipment. We have never broken two leaves in any one follower; only one in a follower occasionally. Our business is chiefly iron ore and our trains are very heavy, carrying on an average of 2,200 tons, and it taken a good solid draft rigging to stand this pull. We have some grades against us varying from 10 to 26 ft. to the mile and our engines are worked to their full capacity, especially with these grades. The blueprints I enclose you I think are plain enough to illustrate the design without any great explanation. It is a very easy matter to replace a spring in this attachment. You will see there is a bottom attachment, and



The Hinson Draft Gear Ore Cars—Duluth, Missabe & Northern Railway.

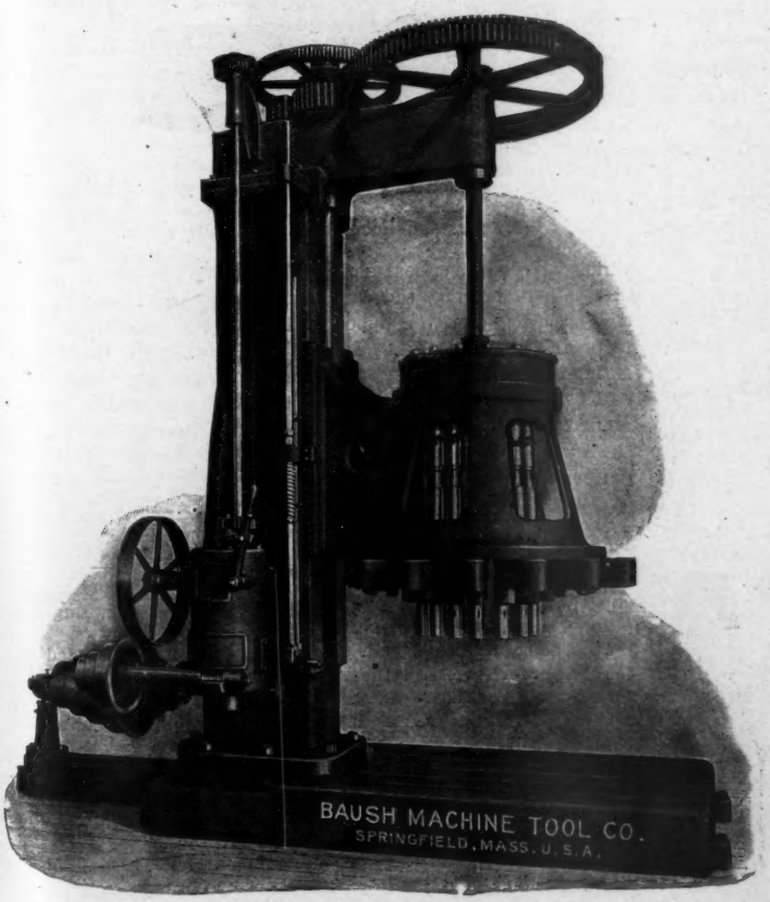
that by taking out a bolt it drops down, allowing free access to the bar. These followers are short and stiff and hard to compress. They cushion the shock to the draft gear, even after the coil spring is closed."

From this testimony it appears that the draft gear has already established a record and is not an experiment. It is manufactured and sold by the National Car Coupler Company, 621 Monadnock Block, Chicago, who also manufacture the other well-known car equipment devices developed by the President of the company, Mr. J. A. Hinson.

MULTIPLE DRILLING MACHINERY.

The Baush Machine Tool Company, Springfield, Mass.

The word "multiple" when applied to a drilling machine may mean much or little, depending upon the adaptability of such a machine for different kinds of work. A machine might be designed with two or more spindles for some particular work and be capable of effecting that work economically and satisfactorily. Such a machine would be a multiple drill, but



when considered as an economical tool for present-day conditions would, of course, fail to meet the claim.

If, however, a machine is so designed and constructed that while filling the requirements of a special tool, it can also without trouble or delay be adjusted to meet the necessities of other work whether its full capacity or otherwise, then such a machine becomes "multiple" in the best sense of the word and is proportionally valuable as a shop tool.

A machine which fully meets these conditions is shown in the accompanying illustration. Not only does it meet the conditions stated, but it effects a result which is not always considered at first thought and that is, that for every spindle working it is saving the time and expense of one other ordinary drilling machine, for taking the factor of handling into account, it will drill as many more pieces in the same time as there are holes in the work.

One great advantage in this machine over some other multiple drills, is the fact that the whole head moves to and from the work by power or hand feed at the will of the operator thus allowing the work to be placed upon the bed plate or table, as desired. Another advantage is that each drill spindle is freely adjustable and independent of the others.

The field which such a machine can cover is wide and varied, and a little thought will show how well adapted it is to any work of a multiple or duplicate character within its range. The sizes regularly built by the company contain four, eight, twelve, fourteen, sixteen and twenty-four spindles, or, in fact, any desired number. The larger sizes are suitable for drills up to 1½ ins. in diameter, while the smaller are designed fo 1-in. drills or less. The space covered varies from a 4-in. circle in the smaller machine to 36 ins. in the larger sizes, and each machine can drill any regular or irregular layout within its capacity.

The Baush Machine Tool Company, Springfield, Mass., make a specialty of these machines which are built under the Baush & Oehring patents.

During the past year the Pintsch system of car lighting was, up to November 1, placed on 1,347 additional cars in the United States alone. This makes a total of about 16,000 cars equipped with the Pintsch compressed-gas system, of which 2,883 are Pullmans. The system is now standard on about 150 railways in the United States and Canada. And of the entire world there are not far from 100,000 cars equipped with this system. These figures would seem to indicate that the progress made during 1900, as to the adoption of the system, has been the greatest in the history of the company. The Safety Car Heating and Lighting Company, which controls in the United States and Canada the Pintsch system, has constructed during the year six gas plants, one at Albany, N. Y., one at Los Angeles, Cal., one at Jersey City, N. J., making three such works at the latter place, a large plant at Montreal, Canada, and also works at Memphis, Tenn., Texarkana, Ark., and Hamlet, N. C., making a total of 55 manufacturing plants for Pintsch gas in the United States and Canada. A further indication of the successful management of the concern is told by the fact that 8 per cent. is paid annually on its capital stock of $3,750,000.

The Philadelphia & Reading Railway will erect a new boiler house at Reading. The structure will be of brick, one-story high, the dimensions being 31 ft. 10 ins. wide by 91 ft. 11 ins. long, supported by stone foundations and covered with granulated slag roofing. Its equipment will consist of boilers and air compressors complete, dust collector and furnace feeder. It will be located on the railway company's property on Sixth street above Oley street, in that city.

The American Machinery & Export Co., recently incorporated under the laws of New Jersey with a capital of $250,000, has opened an office at 15 Cortlandt Street, New York City. The company will deal in all kinds of machinery, principally for export, and will make a specialty of buying for foreign railroads. Mr. Wesley Meeteer, for some time Purchasing Agent of the Jackson & Sharp Co., Wilmington, Del., is Vice-President and General Manager.

A Western railroad has named one of its new sleeping cars "The Links." It will probably be filled with bunkers.

UNIVERSAL HAND OIL PUMP.

Manufactured by The Lunkenheimer Co., Cincinnati, O.

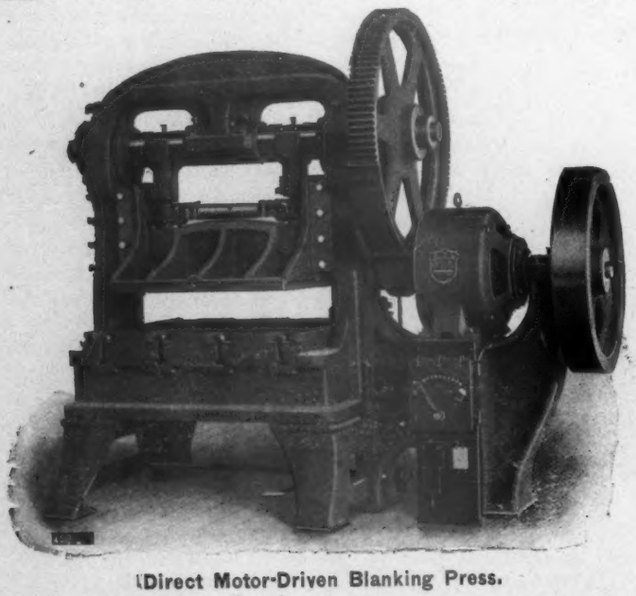
The accompanying engraving illustrates a new form of oil pump, which is easy to fill and operate, works well under high pressure and may be attached either vertically or horizontally, by interchanging the plug marked B in the engraving, with the shank marked A. The body of the oil cup

Universal Hand Oil Pump.

is glass, but may also be made of brass. All parts of the pump are well designed and constructed. The plunger is made heavy and very durable. The oil hole for filling is guarded by a removable wire gauge strainer to prevent dust or grit from entering the pump. This is in turn covered by a hinged cap, H. The finish of the pumps is brass or nickel plate, and ornamental in appearance.

MOTOR-DRIVEN BLANKING PRESS.

The blanking press shown in the accompanying engraving is operated directly by means of a Bullock motor. The machine is compact and powerful and is known as a No. 92 Toledo Punch. The motor is series wound and operated at 240 revolu-



Direct Motor-Driven Blanking Press.

tions per minute, developing at that speed 4 horse-power. It is so placed on the machine that it occupies no more room than the driving pulley of a belt-driven machine. The main switch, rheostat and fuse box are mounted upon a board fastened to the motor support. This unit may be set anywhere on the floor of a shop without reference to line shafting, and from this feature it is possible to economize considerably in floor space and also to move the machine about the shop if necessary. The chief advantage of direct driving in such a case is that a machine may be placed in an outlying building or in any space in the shop over which cranes are to be operated.

HOMESTEAD VALVES.

Manufactured by the Homestead Valve Co., Pittsburg, Pa.

The Homestead valve is a balanced, self-locking valve, so constructed that the best possible service that a valve can render is done in the shortest possible time. It is provided with interlocking and releasing cams, which are operated automatically on turning the handle. The accompanying engraving is of the Homestead locomotive blow-off valve which is so constructed that when closed it is at the same time forced firmly to its seat. This is accomplished by means of a traveling cam which moves vertically in the casing above the tapered plug, but is prevented from turning by two small lugs

Homestead Locomotive Blow-Off Valve.

which travel in vertical slots. By turning the steam in the direction of closing, the cam is caused to move upward and take a bearing on the upper surface of the casing and thus force the plug firmly to its tapered seat. The Homestead Manufacturing Company also make straight-way, three-way and four-way valves in all sizes up to 6 ins., which are intended for high pressure, either steam, compressed air, or hydraulic. Correspondence is invited for valves of special patterns and high pressures.

BOOKS AND PAMPHLETS.

Progress in Flying Machines. By O. Chanute, C. E. 308 pages, 5¾ by 8½ ins. Price, $2.50. Address The American Engineer and Railroad Journal, 140 Nassau St., New York.

This book, written by an engineer of long and extended experience, is a review of the experiments which have heretofore been made to achieve human flight by means of non-buoyant apparatus—that which is heavier than the air—in contradistinction to balloons whose levitation is produced by gas lighter than the atmosphere. The object which the author of the book had in mind in its preparation was to satisfy himself "whether with our present knowledge and mechanical appliances men might reasonably hope eventually to fly through the air?" This question he has answered in the affirmative. In making his investigations he aimed to gather all the records of experiments and attempts at human flight which have heretofore been made, but especially to furnish an account of the more recent achievements in that direction which make it seem less chimerical than it was a few years ago to experiment with flying machines. Having done this he has then aimed to give an explanation of the principles involved in flight and of the results thus far accomplished by others. The book contains nearly a hundred illustrations, and is the most complete and the ablest treatise on the fascinating subject to which it relates in the English, or perhaps, any other language.

Bulletin of the American Railway Engineering and Maintenance of Way Association. Vol. 2, 1900. Published by the Association, 1562 Monadnock Block, Chicago, Ill. Edited by L. C. Fritch, Secretary of the Association.

This, the first bulletin of Vol. 2, contains a very interesting paper on Locomotive Tonnage Rating on the Southern Pacific Railway (Pacific System), by the late Wm. G. Curtis, Engi-

neer of Maintenance of Way. The report was the work of a committee appointed early in 1899 by Mr. Julius Kruttschnitt, General Manager of the Southern Pacific Company, for the purpose of introducing a uniform and consistent system of locomotive tonnage rating. To put this system in form for publication as a paper before the association, Mr. John D. Isaacs, Assistant Engineer Maintenance of Way, re-arranged the experimental and theoretical investigations. The paper as presented to the society, contains, besides the general methods of calculating and practical application of the system to the single-expansion and compound locomotive, a number of extensive tables, with folding plates and diagrams. The bulletin also gives an appendix containing a synopsis of minutes of the Board meetings, list of new members, list of standing committees and mileage tables.

The Gas Engine Handbook. By E. W. Roberts, M. E. Second Edition; revised and enlarged. Published by the Gas Engine Publishing Company, Cincinnati. Price, $1.50.

This little volume of 241 pages, 3½ x 5¼ inches, is a manual of useful information for the designer and engineer. It does not cover the entire subject of gas engine design, but gives a sufficient number of rules and formulas to enable draftsmen to design a gas engine without difficulty. Many of the formulas given are new and have not appeared in any works by other authors. Of the twenty-five chapters of this volume, the first eight contain rules and hints valuable not only to the designer, but to the engineer who has the care of gas engines. The following fourteen are devoted to the design of the various parts and the remaining three chapters give miscellaneous formulas, tables and the necessary operations for testing. This second edition has been revised and enlarged by way of an appendix, including some notes on two-cycle engines and especially upon their design.

Modern Locomotives. Edition of 1901. Illustrations, Specifications, and Details of Typical American and European Steam and Electric Locomotives. Large quarto size, bound in cloth, 532 pages, 837 engravings. Published by The Railroad Gazette, New York, 1901. Price, $7.

The fourth edition of this book has just appeared. It is similar in form and arrangement to the earlier ones, and, being up-to-date and the only publication of the kind, is most valuable to those who have to do with the design and management of locomotives. The work was prepared by Mr. J. C. Whitredge, Associate Editor of The Railroad Gazette. It begins with articles on subjects specially important to the designer, such as: Recent improvements in locomotives, Locomotive tests, Locomotive counterbalancing, Locomotive tests and testing plants. Experiments with exhaust apparatus and Records of fast runs. The entire work is well indexed and the subjects are grouped conveniently. This edition is specially interesting because the additional matter chiefly concerns powerful and notable engines, many of which have appeared since the 1897 edition came from the press. Tables of dimensions accompany nearly every design illustrated, and in addition to this a large number of details applicable to general practice are included. The chief features of the various well-known types of compound locomotives are presented and also of foreign, electric and compressed-air locomotives. In such a work some mistakes and criticisms of various features may be expected, but altogether the work is of such great value that these may be lightly passed over. It is a unique publication which cannot fail to win appreciation.

Motor-Driven Air Compressors.—This new catalogue, just issued by the Westinghouse Air Brake Company, illustrates and describes a line of small electrically operated air compressors for supplying compressed air for car brakes, train signals and various industrial uses. The motor and compressor, which are discussed separately, were designed to occupy the smallest possible space and are illustrated by several different views. An automatic electric pump governor is described and shown separately by a half-tone engraving and also in connection with a diagram of wiring and piping, which explains the method of connecting up the compressor to run from a direct-current trolley circuit, either on a car or in a car station. The pamphlet also gives general directions for starting the compressor and a table of weights and dimensions of the different sizes of motor-driven reciprocating air pumps, manufactured by the Westinghouse Air-Brake Company. The pamphlet is in the usual tasteful style of the Westinghouse companies.

"Draft Without a Chimney" is the title of an interesting little booklet of which the fourth edition has just been issued by the B. F. Sturtevant Company, Boston, Mass. This brings the total number of copies printed up to 50,000. It relates to the experience of the Sturtevant Company, in the use of a fan to produce draft without a chimney in its own works. Copies will be furnished on application.

Rubber Goods.—The Boston Belting Company, of Boston, Mass., manufacturers of all kinds of vulcanized rubber goods, have just issued a little 12-page booklet illustrating and briefly describing various styles and shapes of corrugated and perforated mats and treads for all car and steamship purposes. This company also manufacture rubber hose for every service, together with packings in great variety, gaskets, valves, washers, rubber covered rollers and Eames vacuum brake diaphragms and car vestibule diaphragms.

The Works Management Number of the "Engineering Magazine" contains a collection of valuable articles, all of which concern the problems of successful management of large industrial enterprises. It opens with descriptions of such typical establishments as those of Armstrong, Krupp, Carnegie, Westinghouse and others, followed by no less than fifteen special articles bearing upon the organization and administration which have led to successful results. It is a treatise by the best authorities and cannot fail to exert a powerful influence for improvement upon those who read it, especially if they have responsibilities of their own in the direction of the work of others. The plan of this number and its execution compels admiration. We consider it a duty to our readers to advise them to procure and study these articles. It is a veritable guide-book to the organization, administration and equipment of present-day industrial establishments, including studies of men as well as materials. The address of the "Engineering Magazine" is 120 Liberty Street, New York.

Conveying Machinery.—The Jeffrey Manufacturing Company, Columbus, O., have just issued a new special illustrated catalogue and price-list of conveying machinery, which is a pamphlet of 96 pages of engravings, with accompanying brief descriptions. The first part contains illustrations of machinery in actual service representing a general line of conveyors, elevators, steel cable conveyors, carriers and labor-saving appliances for the lumber and wood-working industries. The latter part is taken up with chains, among which are transfer, steel thimble roller, haul-up, roller carrier, drag and standard detachable chains; also various attachments for these chains, together with lists of prices. These appliances, with slight modifications, are applicable to other classes of work and this company states that estimates and plans will be furnished upon application, together with complete working drawings. Also to those interested this special catalogue No. 57 can be had by addressing the Jeffrey Manufacturing Company, Columbus, O.

Science and Technology Annual.—This annual, a copy of which has just been received, is one gotten out by the students composing the Steam and Machine Design Association and Electrical Association of Pratt Institute, Brooklyn, and is devoted chiefly to the results of some of the regular laboratory work of the first and second-year students, together with papers which they have prepared and read at the regular meetings of the two associations. This volume, which is the first book of this kind attempted by the students, is intended for circulation among their own number and among former members of the associations. This book is interesting in that it shows, from the character of the papers presented and the manner of handling laboratory reports, what the students are able to accomplish in so short a time as two years, and with the comparatively low requirements for entrance. The alumni notes given in the back of the annual are also interesting, as showing the character of positions these students are able to command after graduating from this institution. One is impressed with the demand for such sensible schools as Pratt Institute.

The Sturtevant Engine is the title of a well-illustrated catalogue of steam engines and combined generating sets, built by the Sturtevant Company, Boston, Mass., for electric light plants and general high-grade work. Among the engines illustrated and briefly described are: Automatic engines, both upright and horizontal, including single-valve, double-valve, open and closed types, and compound engines; also automatic and throttling engines and generating sets. These engines represent a development of many years, along the line of simple and compact construction, with a refinement in speed regulation. The pamphlet also gives small diagrams of the various engines, together with a table of the principal dimensions.

The Ransome & Smith Co., manufacturers of concrete mixing mills and concrete appliances, Brooklyn, N. Y., are distributing a series of blotters, one side of which are finished smooth and contain an illustration of the Ransome's Patent Drum Mixer, together with a different testimonial on each blotter, from railroad men and users of their mixers. Mr. W. A. Rogers, Engineer, Bridge and Building Department of the Chicago, Milwaukee & St. Paul Railway, says: "With this the Ramsome machine, the operation is under the observation and control of the operator at all times and mixing may be carried on as long as he desires. In the writer's opinion it is impossible to mix concrete any better than it is mixed by this machine."

History of the Britannia Tubular Bridge.—In this pamphlet is printed a paper on the celebrated Britannia Tubular Bridge, by Mr. Clement E. Stretton, Consulting Engineer, Sax-Coburg House, Leicester, England. This bridge, which carries the Chester and Holyhead Railway system over the Menai Straits, was completed and opened the 21st of October, 1850, and on the celebration of its jubilee, which was attained the 20th of October, 1900, this paper was presented by the author. Besides a full-page engraving, the paper gives a general description, together with an interesting history of the construction of the bridge.

The Brill Convertible Car.—The J. G. Brill Company, of Philadelphia, have fully described in their catalogue a new form of street car for use all the year round. It contains a number of full-page engravings made from photographs of cars of this kind recently built by them. These cars when closed are, in appearance, identical with the standard closed car, and when open the points of difference between them and the ordinary open car can hardly be detected. The distinctive features of the convertible car are shown by a number of half-tone engravings of cross-sections of the car and roof. The posts are of the ordinary pattern, bent at the lower part to conform to the curve of the car side, and carry the panels and windows as well as roller curtains. These are all concealed in a pocket in the roof, out of sight, and held in place by a sash lock. The panels, which are flexible, slide in grooves in the posts, and when lowered into position close the side of the car to the height of the ordinary window rail. When the panels have been let down, the sash, which is made in two parts, hinged together, is lowered into place. Among the important advantages of the convertible car, as given in the pamphlet, are the single equipment of bodies, trucks and motors, and the saving of capital, interest and depreciation.

EQUIPMENT AND MANUFACTURING NOTES.

Mr. Jos. H. Williamson, Business Manager of the Viennot Advertising Agency, has removed his New York office from No. 127 Duane Street to room No. 719, Temple Court, where he will be pleased to see his acquaintances.

The Missouri Pacific has placed an order with the American Car & Foundry Company for 2,500 of the latest design box cars, of 60,000 pounds capacity. These cars are to have all of the best and most up-to-date devices in railroad use, among which are specified the Shickle, Harrison & Howard Iron Company's cast steel, Player trucks and body bolsters.

The Q. & C. Company and the Railroad Supply Company have consolidated and will operate under the name of the Railroad Supply Company, with D. S. Wegg as Chairman of the Board and C. F. Quincy as President. The general offices will be in the Bedford Building, Chicago, and the New York office at 106 Liberty street.

Mr. O. M. Edwards, manufacturer of the Edwards Window Fixtures, Syracuse, N. Y., held an exhibition of his devices for opening and closing car windows, at the Imperial Hotel, New York City, January 17 and 18. Models of windows were shown with these fixtures in working order, and many points of advantage were made apparent by them. The principal features of the fixtures are a torsion roller balance for raising and lowering the window sash, a worm gear to regulate the tention of the roller, friction strips bearing against the sides of the sash to make tight joints and a double thumb catch used in operating the friction strips, which secures the sash when closed and in turn allows the sash to move upward when released. Besides these window fixtures, there was on exhibition the Edwards Wide Vestibule Extension Platform Trap Doors, which are being used successfully on a number of railroads for automatically opening the traps when the catch holding the door down, is released. Mr. Edwards' models are of superior workmanship and they give an immediate impression of simplicity, durability and general satisfaction with the devices.

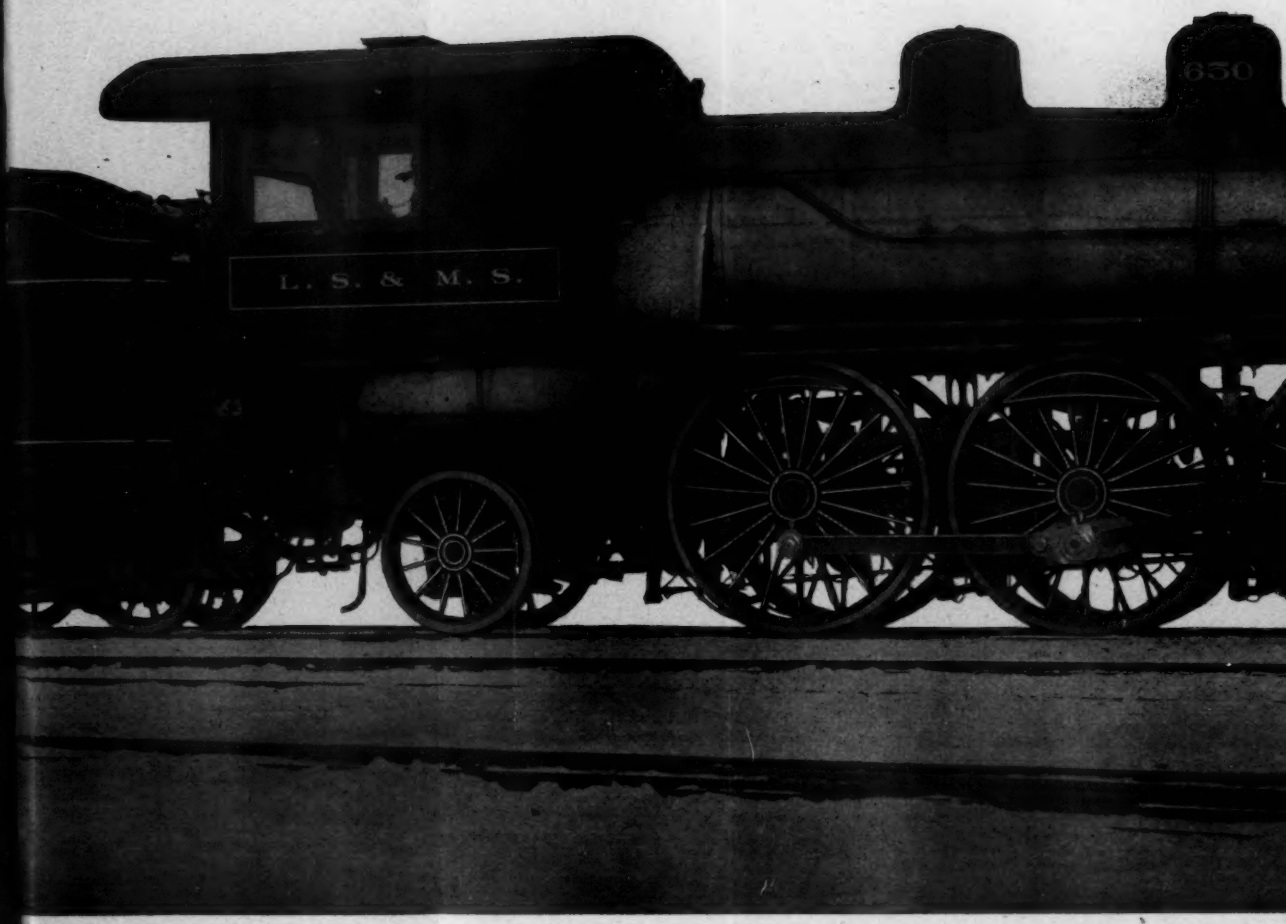
The Richmond Locomotive and Machine Works have just received an order from the Wabash Railroad for 50 locomotives, of which 34 are to be 2-cylinder compound moguls, 6 will be 10-wheel passenger locomotives, 6 Atlantic type passenger locomotives, and 4 switching locomotives. The mogul engines will have 19-in. by 28-in. cylinders and 56-in. driving wheels; the weight of each engine in working order will be about 130,000 lbs., of which 110,000 lbs. are on the drivers and 20,000 lbs. on the truck; the boiler is 60 ins. in diameter with 2-in. tubes, 11 ft. 4⅝ ins. in length; the firebox will be 108 ins. long and 42⅝ ins. in width, and the tank capacity 5,000 gals.

The general dimensions of the 10-wheel passenger engines are: Cylinders, 19 ins. by 28 ins.; diameter of drivers, 66 ins.; weight of engine in working order, about 147,000 lbs.; weight on drivers, about 112,000 lbs., and on truck, about 35,000 lbs.; boiler, radial stay, 62 ins. in diameter; length of firebox, 120 ins., and width, 42⅝ ins., and tank capacity, 5,000 gals. The switching engines will have 18-in. by 24-in. cylinders; driving wheels, 44 ins. in diameter; weight on drivers about 102,000 lbs.; radial stay boiler 60 ins. in diameter with 2-in. tubes, 10 ft. 4½ ins. in length; firebox, 84 ins. long and 33⅜ ins. wide, and the tank a capacity of 3,000 gals.

With the beginning of the new century, work was started in the new boiler shops of the Babcock & Wilcox Company at Bayonne, N. J., where the company purchased thirty acres of land, having a frontage of 650 ft. on the Kill von Kull, with a depth of water 25 ft. on the pier line. These works are the largest of their kind in the world. The buildings so far completed have a floor area of about 160,000 sq. ft., to which will be added at once buildings of approximately 40,000 sq. ft. floor area. The plant is equipped throughout with special tools and has been designed with the greatest care to expedite the processes of manufacture by reducing to the last degree the needless handling of material and by the use of the most approved appliances. The works of the company have hitherto been located at Elizabethport, N. J., but the growth of the business in later years made necessary an increase in productive capacity and in 1899 the company decided to build the new works now nearing completion. The site chosen is an ideal one. So large a tract of land with as desirable a water frontage close to New York City is exceedingly difficult to obtain. It consists wholly of solid ground, no piling having been used for either the buildings or the heavy foundations required for the macinery installed. A spur track from the Central Railroad of New Jersey enters the property, so that the company enjoys the best of facilities for shipping both by rail and water. The famous water-tube boilers manufactured by The Babcock & Wilcox Company have a world-wide reputation. The success of the water-tube boiler dates from the first boilers of their manufacture. In addition to the enormous business which they are doing in stationary boilers the company have in the last few years entered into the manufacture of marine water tube boilers which are now extensively used in the United States Navy, are being introduced in the British Navy and are very widely used in the merchant marine.

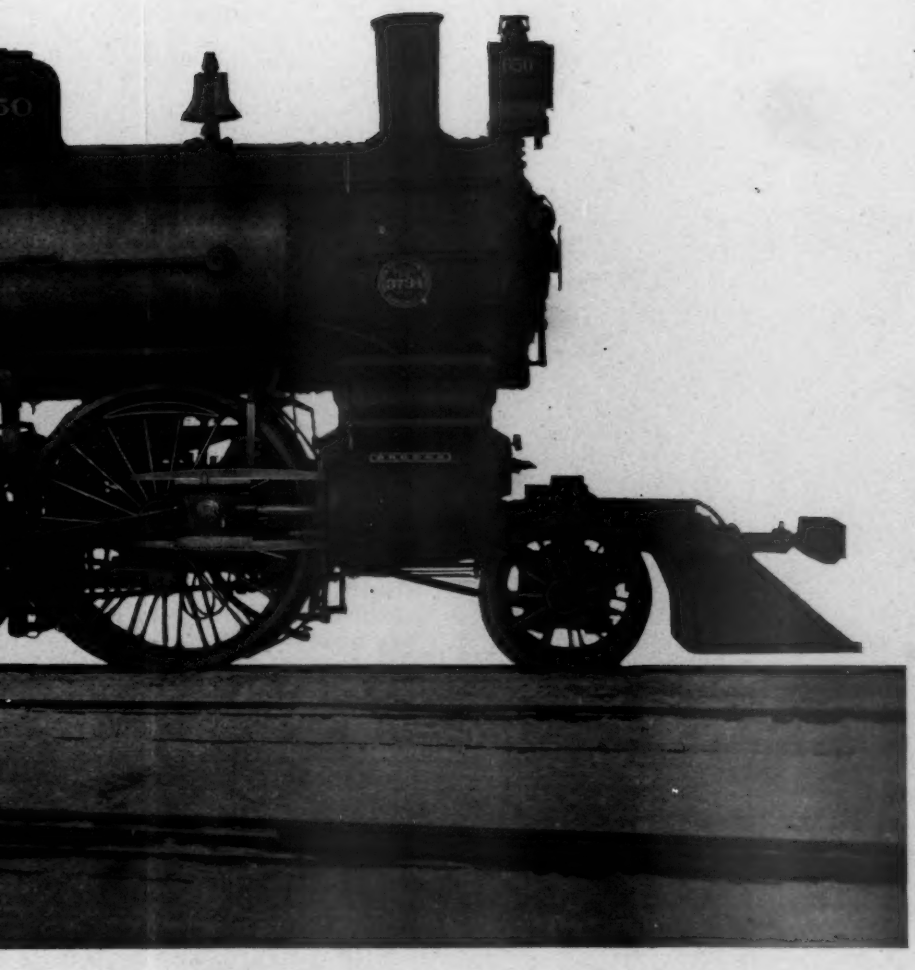
FAST PASSENGER LOCOMOTIVE, LAKE SHORE CLASS "J."

DESIGNED BY W. H. MARSHALL, SUPERINTENDENT MOTIVE POWER, CLEVELAND, OHIO.



ENGER LOCOMOTIVE, LAKE SHORE & MICHIGAN SO
CLASS "J."

LAND, OHIO.



SOUTHERN RAILWAY.

BUILT BY BROOKS LOCOMOTIVE WORKS, DUNKIRK, N. Y.